UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

IMPACT OF BANK BAILOUTS ON MEDIUM TERM ECONOMIC GROWTH

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INTRODUCTION

Banks play an important role in the economy. Rajan (1998) identifies their main functions as: liquidity provision (for borrowers and lenders) and funding of complex positions (e.g. granting loans to smaller, riskier firms). To perform these roles, banks need to take some risk: *"we cannot get many of the good things banks do, such as liquidity creation, credit origination, and financial innovation, without banks issuing claims susceptible to runs and thus being financially fragile"* (Rajan, 1998, paragraph 24). Research shows that recessions are deeper and result in higher levels of government debt when they are accompanied with bank crises (Baron, Verner & Xiong, 2018). For instance, Bernanke and James (1990, abstract) say that: *". . . countries which (for historical or institutional reasons) were more vulnerable to severe banking panics also suffered much worse depressions . . . "*.

There is a strong belief that distressed banks, especially systemically important ones, should not be allowed to fail.[1] As Calomiris and Manson (2003, p.1) write: *"The central questions of policy reference do not revolve around whether to bail out banks, but rather around the choice of which banks to rescue and the means for doing so..."*. A similar sentiment was recently expressed by Nicolaisen (2015, p.4) who said that: *"The question becomes how, rather than whether, banks should be bailed out. Or more directly: Who should be bailed out?"*.

This attitude towards bank bailouts is not new. State aid for distressed financial institutions has existed for at least a century (Todd, 1992; A. Banerjee, 2017). In the 1890s when Barrings bank got into trouble, its peers and the Bank of England provided liquidity support and guarantees (White, 2016). The US government aided commercial banks during the Great Depression by purchasing their preferred shares (Bobroff, 2009). In this thesis, any government lead recapitalization or purchase of bad assets is regarded as a bailout. Using our definition, the US support of banks would be considered a bailout, while the aid to Barrings would not.

Bailouts restore the confidence in the financial system and dampen the effects of financial crises on the real economy. However, they are costly and contribute to the increase in public debt. Between 2008 and 2014, the total debt of European Union (EU) states increased from €7.9tn (60% of GDP) to €12.2tn (87% of GDP). Bank bailouts accounted for about €0.5tn of this the new debt burden (European Commission, 2017). In the US, bank bailouts were conducted in 2008 and 2009. Over this period the federal debt increased from \$9.4tn (63% of GDP) to \$12.7tn (87% of GDP). In this case, bailouts added about \$0.7tn in new debt (Lybeck, 2011).

[1] Systemically important institutions are those *"whose failure would cause significant disruption to the wider financial system and economic activity."* (The Global Financial Markets Association, n.d.).

Bailouts prevented the financial system from collapsing, but as illustrated before, they account for about 10% to 20% of the newly issued debt. Laeven and Valencia (2010) find that an increase of government debt may have a negative impact on future GDP growth. Given that bank bailouts are very costly and not that rare, their effect on GDP growth needs to be explored. Bailouts may also influence GDP growth by affecting credit allocation. Giannetti and Simonov (2012) find that depending on their size, bailouts may channel lending either to riskier firms, including zombie firms, or to healthier firms. This can either decrease or increase productivity, which would negatively or positively affect economic growth. In this master's thesis we attempt to analyze the relationship between bank bailouts and medium-term economic growth. We want to answer the question whether countries that experience a bank crisis and bail out their banks have higher medium-term growth rates than those that have a crisis, but do not bail out their banks. We are interested in the sign of this effect. While we also quote its magnitude, we are skeptical about the informativeness of this measure (we explain our reasons for this in section four).

We approach the research problem by collecting data on bank bailouts and some economic indicators for 41 developed countries over a period of 23 years (1992-2014). We perform a slightly modified version of a growth regression, popularized by Robert Barro (1991, 1996). In growth regressions the average GDP growth rate is explained using a set of economic variables or covariates. This allows us to estimate the "contributions" of individual covariates to growth. We augment Barro's model by adding bank crises and bailout dummies to estimate their effects on growth. The sample is split in four five-year periods. We estimate the model using the seemingly unrelated regression (SUR) estimator, where the coefficients are restricted to be the same in all periods (i.e. pooled SUR). To ensure that the results are robust to model specification we use model averaging techniques and perform robustness tests.

The outline of the thesis is as follows, first we review the literature on growth regressions and bailouts. In the next section we present our econometric model and hypotheses. After that we explain the econometric difficulties with growth regressions and present our approach for tackling them. Section four also summarizes the econometric theory behind the SUR estimator. In the successive section, we present the data used. In section six, we present and discuss the results. The robustness tests are also shown in this section. Finally, we conclude the thesis in section seven.

1 LITERATURE REVIEW

1.1 Bailout literature

Over the years a wide range of literature examining issues related to bailouts has developed. The following themes have been explored (Calderon & Schaeck, 2016; Orlowski, 2010, p.6):

1. **Efficacy of bailouts**: Do bailouts work? What is their effect on macroeconomic variables?

2. **Efficiency of bailouts**: Are bailouts the best use of government resources?

3. **Moral hazard**: Managements of large commercial banks know that, if they get in trouble, they will be bailed out to protect the deposits. This incentivizes them to take more risk, knowing that taxpayers will cover their loses. This asymmetry between those who bear the losses and enjoy the gains is known as moral hazard. An area of bailout literature examines how to limit it.

4. **Systemic risk**: How do the expectations of bailouts for banks which are deemed too big to fail (TBTF) contribute to build up of systemic risk?[2]

5. **Competition**: What is the effect of bailouts on competition?

This thesis deals with the efficacy of bailouts (point one). More precisely, we want to examine the medium-term impact of bailouts on GDP growth. We do this by including bailout dummies in our growth model (explained in the following section). We analyze the growth rates over five period intervals, so the medium-term growth is defined as the average growth rate in the interval following a bailout. Similarly, we would define the short- and long-term growth rates as those inside the same interval and those two intervals later, respectively.

When a bank crisis occurs, various measures are implemented to support the banks, including bailouts, liquidity assistance[3] and state guarantees. We define a bank bailout as government assistance, either in the form of recapitalization or the purchase of bad assets. Ideally the purchases of bad assets would not be counted in the bailout amount. However, the available data does not differentiate between the two measures. The data on liquidity assistance and government guarantees is more difficult to find. Therefore, we cannot disentangle the short-term effect of various aid measures. This prevents

[2]Sometimes defined as: *"... the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainly about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy." (Group of Ten, 2001, p.126)*

[3]This form of aid is most frequently provided by the central bank.

us from studying the short-term effect of bailouts on GDP growth. To estimate the medium-term effect of bailouts we make two assumptions. Firstly, we assume that only an increase in the stock of government guarantees affects economic growth. We also postulate that by the start of the next five-year period, the stock of guarantees has stabilized. Secondly, we assume that liquidity assistance is temporary and disappears by the start of the next five-year interval. These two assumptions are untestable and central to our thesis. We were unable to find any literature references which would support or dispute them.

There are a couple of reasons why we focus on medium- rather than long-term effects of bailouts. Few countries have long time series of key economic variables. Even fewer have data on bank bailouts. In addition, the short- and long-term effects of bank bailouts have already been explored.[4] Bank bailouts were found to increase short-term GDP growth (Bakare, 2011; Berger & Roman, 2017). However, they are costly and, on average, significantly increase the debt to GDP ratio (Furceri & Zdzienicka, 2010). The resulting high level of debt limits governments' fiscal space in future crises, which may negatively affect future GDP growth (Laeven & Valencia, 2010).

Giannetti and Simonov (2012) find that when bailouts are too small, they may stimulate lending to riskier and less productive firms. This includes "zombie firms"[5]. Banks refinance loans to "zombie firms" to avoid taking a hit to their capital. Consequently, access to finance and investment of healthy firms decreases (Andrews & Petroulakis, 2017). Investment is one of the key drivers of GDP growth (Orji & Mba, 2010). By impeding it, bailouts may lead to lower medium-term economic growth. Additionally, zombie firms are less productive, which drags down the overall productivity of the economy (McGowan, Andrews & Millot, 2017; Caballero, Hoshi & Kashyap, 2008). This negatively affects medium-term GDP growth. That said, Giannetti and Simonov (2012) also find that if the bailout is large enough, meaning that banks are well capitalized after the bailout, lending to zombie firms decreases and lending to healthy firms increases. Therefore, it is not entirely clear whether bailouts impede or support investment and whether their effects on medium-term economic growth are positive or negative.

The literature on the medium-term effects of bank bailouts on economic growth is scarce. However, there is a fairly extensive literature on the effects of the International Monetary Fund (IMF) and World Bank (WB) country bailouts. Most papers conclude that IMF bailouts have a negative effect on medium- and long-term growth (Barro &

[4] Note that various authors use different definitions of time horizons. When discussing their papers, we use their terminology. When discussing our analysis, we use our definitions of time horizons.

[5] Zombie firms are companies that are: *"... unable to cover debt servicing costs from current profits over an extended period ..."* (R. Banerjee & Hofmann, 2018, p.67)

Lee, 2005; Hutchison & Noy, 2003; Detragiache & Ho, 2010; Dreher, 2006). Bordo and Schwarz (2000) are one of the few who identify a positive effect of country bailouts. They find that the IMF bailouts increase the speed of the recovery, but do not affect the subsequent growth rate.[6], [7] In summary, based on the literature review, we postulate that bank bailouts have a negative effect on medium-term growth.

1.2 Growth regressions literature

To estimate the effect of bailouts, we first need to have a model that describes GDP growth rates as a function of macroeconomic variables. In the economic literature these models are known as growth regressions. In this section we present growth regression models. Growth regressions became popular in late 1980s and early 1990s. The aim of early studies was to test the theoretical growth models.[8] Cross-country data was used to estimate the effects of macroeconomic variables on the average GDP growth rate. The underlying econometric model was:

$$y_i = x_i' \cdot \beta + u_i \tag{1}$$

where:

- y_i is the average GDP growth rate in country i.
- $x_i \in \mathbb{R}^{k \text{ x } 1}$ is a column vector of covariates for country i.
- $\beta \in \mathbb{R}^{k \text{ x } 1}$ is a column vector of coefficients (same for all countries).
- u_i is the error term for country i.

In the early papers x_i always included: income (proxied by GDP/capita), human capital (proxied by education attainment rates) and capital formation (proxied by investment/GDP). The inclusion of these covariates has a theoretical justification in the early growth theories, especially in the Solow model (Cass, 1965; Solow, 1956; Swan, 1956). Examples of early studies include Barro (1991) and Mankiw, Romer and Weil (1992). Both papers apply versions of Equation 1) on a set of 98 countries and use the previously mentioned variables (income, human capital and capital formation). The goal is to explain the average GDP growth rate over the period 1960-85. The coefficients are estimated using the OLS estimator.

[6]Interestingly, Butkiewicz and Yanikkaya (2005) find that WB loans may be positive for growth while the IMF programs are at best growth neutral.

[7]There is also a developed literature looking at the effect of aid on economic growth (e.g. see (Subramanian, 2008)).

[8]These are outside the scope of this thesis.

Table 1: The number and lengths of periods in the literature.

Period length (years)	Number of periods	Study
10	3	Fisher (1993)
5	3	Islam (1995)
5	3	Knight, Loayza and Villanueva (1996)
5	6	Dewan and Hussein (2001)
5	5	Durlauf, Johnson and Temple (2005)
5	3	Iradian (2007)
10	4	Moral-Enrique (2010)
1	15	Abdullah (2012)

Source: own work.

Over the years, more covariates were included in growth regressions. Covariates like inflation rates, proxies for democracy, life expectancy and world region dummies were considered. See Levine and Renelt (1992) or Sala-i-Martin (1997) for a more comprehensive, but far from exhaustive list of possible covariates. With the passage of time, the length of macroeconomic time series increased. Instead of performing just one cross-sectional regression on all the available data (as Barro (1991) and Mankiw, Romer and Weil (1992) did), some researchers split the data into multiple periods (see Table 1).[9] Each period was represented by its own equation, resulting in a system of cross-sectional equations. The coefficients of such systems were estimated using the pooled OLS estimator. Alternative estimators like SUR and 3SLS were also used (more on this later) (Barro, 1996; Fisher, 1991, 1993; Zellner, 1962). Very often, a homogeneity restriction was imposed on covariate coefficients.

Some researchers used more traditional panel methods, e.g. a fixed effects estimator, to estimate the growth regression coefficients (Fisher, 1991; Knight, Loayza & Villanueva, 1993; Islam, 1995; Dewan & Hussein, 2001). We do not discuss this approach further, as we decided to estimate the coefficients of growth regressions in a different way.

[9] This increased the number of available data points, but it also opened the question about the optimal period length. Annual data would maximize the number of data points, but it would create other problems: (a) time series would include a lot of noise and short-term fluctuations related to the business cycle, (b) many covariates are (i) not available on an annual frequency, (ii) lack of variability on short time-scales (Durlauf, Johnson & Temple, 2005).

2 MODEL AND HYPOTHESES

2.1 Econometric model

In this section we formally introduce the econometric model. It is an extension of the standard cross-sectional growth regression (Eq. 1) and encompasses multiple time periods. We further augment it with dummy variables which denote the presence of bank crises and bailouts. Rather than having just one model which would include all ten covariates (see section 4.2 for their list), we consider a family of models so that all the covariate combinations are considered. An individual model is denoted as $\mathcal{M}_m$ and includes k_m covariates ($k_m \in [0, 1, 2, \dots K], K = 10$). Together there are $\mathrm{M} = 2^K = 1024$ different models. An individual model $\mathcal{M}_m$ is defined as:

$$y_{i,t} = \lambda_t + D^1_{i,t} \cdot \delta + D^2_{i,t} \cdot \psi + D^3_{i,t} \cdot \mu + x'_{i,t}(m) \cdot \beta(m) + u_{i,t} \tag{2}$$

– The index i denotes the country $i \in [1, 2 \dots N], N = 41$.

– The index t denotes the time period $t \in [1, 2 \dots T], T = 4$.

– Here $x_{i,t}(m) \in \mathbb{R}^{k_m \text{ x } 1}$ is the vector of covariates and $\beta(m) \in \mathbb{R}^{k_m \text{ x } 1}$ is the vector of coefficients.

The $D^1_{i,t}$, $D^2_{i,t}$, $D^3_{i,t} \in \mathbb{R}^{\text{NT x 1}}$ are dummy vectors, their elements are defined as follows:[10]

$$D^1_{i,t} = \begin{cases} 1, & \text{if in country } i \text{ in period } t\text{, there was a bank crisis.} \\ 0, & \text{otherwise.} \end{cases}$$

$$D^2_{i,t} = \begin{cases} 1, & \text{if in country } i \text{ in period } t-1\text{, there was a bank crisis.} \\ 0, & \text{otherwise.} \end{cases}$$

$$D^3_{i,t} = \begin{cases} 1, & \text{if in country } i \text{ in period } t-1\text{, there was a bank crisis and a bailout.} \\ 0, & \text{otherwise.} \end{cases}$$

We write the Equation 2 as:

$$y = X(m) \cdot \Theta(m) + u(m)$$

Where, $m \in [1, 2, ...M], M = 1024$. The following notation is used:

– $y \in \mathbb{R}^{\text{NT x 1}}$ is the vector of dependent variable. It denotes the average GDP growth rate of country i in period t.

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_4 \end{bmatrix} \text{ its elements are } y_t = \begin{bmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{41,t} \end{bmatrix} \text{ and } y_t \in \mathbb{R}^{\text{N x 1}}$$

[10] We also perform a robustness test by specifying $D^3_{i,t}$ as a non-binary dummy.

– $X(m) \in \mathbb{R}^{\text{NT x } (k_m+4)\text{T}}$ is the covariate matrix.

$$X(m) = \begin{bmatrix} X_1(m) & 0 & \dots & 0 \\ 0 & X_2(m) & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & X_4(m) \end{bmatrix} \text{ its elements are}$$

$$X_t(m) = \begin{bmatrix} 1 & D^1_{1,t} & D^2_{1,t} & D^3_{1,t} & x'_{1,t}(m) \\ 1 & D^1_{2,t} & D^2_{2,t} & D^3_{2,t} & x'_{2,t}(m) \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & D^1_{41,t} & D^2_{41,t} & D^3_{41,t} & x'_{41,t}(m) \end{bmatrix} \text{ and } X_t(m) \in \mathbb{R}^{\text{N x } (k_m+4)}$$

– $\Theta(m) \in \mathbb{R}^{\text{T}(k_m+4) \text{ x 1}}$ is the vector of coefficients.

$$\Theta(m) = \begin{bmatrix} \Theta_1(m) \\ \Theta_2(m) \\ \vdots \\ \Theta_4(m) \end{bmatrix} \text{ its elements are}$$

$$\Theta_t(m) = \begin{bmatrix} \lambda_t \\ \delta \\ \psi \\ \mu \\ \beta(m) \end{bmatrix} \text{ and } \Theta_t(m) \in \mathbb{R}^{(k_m+4) \text{ x 1}},\ \beta(m) \in \mathbb{R}^{k_m \text{ x 1}}$$

– $u \in \mathbb{R}^{\text{NT x 1}}$ is the vector of errors.

$$u = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_4 \end{bmatrix} \text{ its elements are } u_t = \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ \vdots \\ u_{41,t} \end{bmatrix} \text{ and } u_t \in \mathbb{R}^{\text{N x 1}}$$

2.2 Hypotheses

We aim to test the following hypotheses:

H_1: *The average medium-term GDP growth of countries which had a bank crisis and bailed out banks is lower than the growth of countries which had a bank crisis but did not bail out banks i.e.* $\mu<0$.

To ensure that our model is well specified we also test the following hypotheses and compare the results to the literature:

H_2: The average medium-term GDP growth of countries which had a bank crisis is higher than for countries that did not have a bank crisis (i.e. "base effect") i.e. ψ>0 (Ranciere, Tornell & Westermann, 2005).

H_3: Bank crises have a negative impact on average short-term GDP growth i.e. δ<0 (Reinhart & Rogoff, 2009).

3 ECONOMETRIC CHALLENGES AND ESTIMATION

3.1 Econometric challenges

As growth regressions began appearing in the literature, several econometric problems were identified. Durlauf (2009) groups them into three categories: variable endogeneity, model selection and exchangeability. They are discussed in turn. We also explain how we aim to address these problems in the thesis.

3.1.1 Variable endogeneity

Endogeneity occurs when the error term is correlated with covariates $E(x_i \cdot u_i) \neq 0$. Hauk (2017) identifies reverse causality, simultaneity and omitted variables as the main sources of endogeneity in growth regressions. We briefly explain the intuition behind these sources of endogeneity (for technical explanations see Wooldrige (2012)).

In a simple growth regression (Eq. 1) we assume that changes in independent variables lead to a change in the dependent variable. We represent this graphically as $\Delta x_i \rightarrow \Delta y_i$. Reverse causality is a situation in which the changes in dependent variables lead to changes in independent variables $\Delta y_i \rightarrow \Delta x_i$. Simultaneity is a closely related problem. It occurs when changes in dependent and independent variables are intertwined $\Delta y_i \leftrightarrow \Delta x_i$. Growth regression studies often suffer from reverse causality or simultaneity because of the way how covariates are constructed. For instance, when Barro (1991) tries to explain the average GDP growth between 1960 and 1985, one of his covariates is investment. It is constructed by the taking the average of investment between 1970 and 1985. The problem can arise because while investment leads to growth, growth also leads to more investment (Orji & Mba, 2010). Because the intervals of growth and investment are overlapping, this can result in endogeneity. Endogeneity is problematic, because in these cases OLS is no longer a consistent estimator.

The general way to deal with endogeneity arising from simultaneity or reverse causality (assuming the model is correctly specified) is to use instrumental variables. They can be applied both to individual equations (Fisher, 1991, 1993; Frankel & Romer, 1999) and to systems of equations (Barro, 1996; Berthold & Gründler, 2012).[11] Instrumental variables are widely used in growth regressions. Durlauf and Brock (2001) point to cases where their validity is questionable.[12] For example, they criticize Frankel's and Romer's (1999) use of geographical characteristic of the country (i.e. its size and proximity to other states) as instruments for trade. Durlauf and Brock (2001, p.238) argue that country's size and location may be uncorrelated with growth directly, but there is still a problem of omitted variable bias. In their words: "*Is it plausible that country land size is uncorrelated with the omitted growth factors in their regression? The history and geography literatures are replete with theories of how geography affects political regime, development, and so on.*". This means that a country's geographical characteristics may not be appropriate instruments. Good instruments are hard to come by; therefore, it is useful to try and address variable endogeneity without needing to use instruments.

An alternative approach to tackling endogeneity is to modify the way covariates are constructed. Wagner and Hlouskova (2005) do not use contemporary covariate values. Instead, they construct the covariates based on values from the previous periods. This aims to address the problems related to reverse causality and simultaneity bias.[13] This is because covariate values from period $T-1$ are used when explaining the growth rate in period T. We will follow their approach when constructing the covariates (details are presented in section 4.2).

The omitted variable bias is another identified source of endogeneity. It occurs when we exclude a covariate that has an impact on the dependent variable and is correlated with one or more covariates in the model. In a growth regression this is likely to occur, because of the large number of possible covariates. We can never be sure that all the relevant covariates were included in the model, especially if the model is purely empirical. This source of endogeneity is difficult to address, the best we can do is to choose the covariates that a have theoretical basis in the literature on economic growth and are widely acknowledged to be significant for growth.

3.1.2 Exchangeability

Early growth regressions assumed that (a) growth rates in different countries or groups of countries could be explained using the same econometric model, (b) when the data

[11] Most often by using Zellner's (1962) three-stage-least squares (3SLS) estimator.

[12] An instrument z is valid when it is not correlated with the error term $E(z \cdot u) = 0$ (assuming $E(u) = 0$).

[13] Up to the serial correlation.

is split in several periods (to benefit from temporal information in data) the covariate coefficients are constant in time. These two assumptions are called exchangeability (Brock & Durlauf, 2001).

The literature shows that the exchangeability assumptions are often violated. Chirwa and Odhiambo (2016, p.41) find that developed and developing countries have different growth determinants. Abdullah (2012) identifies differences in growth relationships for countries on different continents. Furthermore, Durlauf and Johnson (1995, p.365) find that countries need to be *"grouped according to initial conditions"*. While not all studies find statistically significant differences between groups of countries, restricting the model to just one type of countries, e.g. developed ones may still be prudent. We follow this approach and only include developed countries in our sample (for details see section 4.1).

The other part of the exchangeability assumption is observable in the pooling of regression coefficients across equations (or time periods). In almost every growth regression study, the coefficients are assumed to be the same for all periods. In other words, β, δ, ψ and μ do not have any time indices. This homogeneity assumption can be tested using an F test. We perform this test as a part of robustness analysis.[14] The null hypothesis of the test H_0 is that coefficient values are the same value across periods. We can reject H_0 if $F > F_{crit}$, where $F_{crit} \sim F_{q,TN-l-1}$. The F statistic is calculated as:

$$F \equiv \frac{(SS_R - SS_U)/q}{SS_U/(TN - l - 1)} \tag{3}$$

where SS_R and SS_U are the sums of restricted and unrestricted squared residuals, q is number of restrictions in the restricted model, TN is the number of data points and l is the number of estimated parameters in the unrestricted model (Wooldridge, 2012, p.146-7).

3.1.3 Model selection

Almost every growth regression study warns that results are not robust (Brock & Durlauf, 2001). The statistical significance and signs of covariates x_i are affected by the combination of covariates used. For instance, "rule of law" may be a statistically significant covariate when combined with GDP/capita and investment, but not when used together with investment and total female fertility.[15] Researchers tried to isolate the core set of covariates whose signs and statistical significance are stable. Most no-

[14] We select a sample of five models with the highest AIC and BIC weights to do the robustness tests.

[15] Note the example is fictional and simplified. In reality, we have more than three covariates, so the situation is even more complicated.

table are the studies by Levine and Renelt (1992) and Sala-i-Martin (1997). However, Durlauf et al. (2005) conclude that little success was achieved.

One way to address the issues with robustness of results is to use model averaging. Different criteria can be used to compute the model weights. We use the approach of Wagner and Hlouskova (2013) whose model averages are based on the Akaike information criterion (AIC), Bayesian information criterion (BIC) and equal weighting (EWE). We first calculate the values of AIC and BIC using the following equations (Claeskens & Hjort, 2008):

$$\mathrm{AIC}_m = N \ln(|\hat{\Omega}_m|) + 2 \dim(\mathcal{M}_m) \tag{4}$$

$$\mathrm{BIC}_m = N \ln(|\hat{\Omega}_m|) + \ln(N) \dim(\mathcal{M}_m) \tag{5}$$

The symbols have the following meaning: $|\hat{\Omega}_m|$ is the determinant of the variance-covariance matrix of the estimated coefficients, $\dim(\mathcal{M}_m)$ is the number of covariates in the mth model, M is the number of models and N is the number of data points.

Once we have the values of AIC and BIC, the weights for a model $\mathcal{M}_m$ with k_m covariates can be computed as (Claeskens & Hjort, 2008):

$$\text{AIC weight: } w_m = \frac{\exp(-0.5AIC_m)}{\sum_j \exp(-0.5AIC_j)} \tag{6}$$

$$\text{BIC weight: } w_m = \frac{\exp(-0.5BIC_m)}{\sum_j \exp(-0.5BIC_j)} \tag{7}$$

When all models are assigned equal weights (EWE), the weight of an individual model $\mathcal{M}_m$ is simply:

$$\text{EWE (uniform) weight: } w_m = \frac{1}{M} \tag{8}$$

Once the weights w_m of individual models are calculated, we calculate the weighted average as:

$$\hat{\beta}_{avg} = \sum_{m=1}^{2^{10}} w_m \cdot \hat{\beta}(m) \tag{9}$$

There are two ways how this can be done, by conditional and unconditional averaging. The conditional estimate includes only $2^{K-1} = 2^9 = 512$ coefficient estimates. It ignores the models where the covariate is not included. In contrast, the unconditional estimate includes all the models, assigning a coefficient value of zero to models which do not included the coefficient.

Weights do not have to be computed based on AIC or BIC. Other weighting schemes also exist, for instance, Sala-i-Martin, Doppelhoffer and Miller (2004), Fernandez, Ley and Steel (2001) and Durlauf, Kourtellos and Tan (2008) use Bayesian model averaging methods to compute the model weights. Durlauf et al. (2005) argue that, regardless of its exact implementation, model averaging is widely recognized as the most promising approach for dealing with model uncertainty.

3.2 Interpretation of results

Early growth regression studies, like Romer (1989) and Mankiw, Romer and Weil (1992) focused on identifying the significance and the "correct" sign of the covariates whose inclusion was supported by economic theory. Many researchers like Sala-i-Marin (1997) and Levine and Renelt (1991) looked for statistical regularities and included covariates which are not present in theoretical models of economic growth. All these studies made it very clear that correlations or association between covariates and growth rates do not imply causation. Some academics, like Barro, went a step further and used their results to make policy recommendations. Barro's (2003, p.251) claims about democracy illustrate this approach well: *"Therefore, democratization appears to enhance growth for countries that are not very democratic and to retard growth for countries that have already achieved a substantial amount of democracy"*. Durlauf (2009, p.325) is skeptical of this approach and argues that growth regressions should be seen as: *"a tool for pattern recognition and construction of stylized facts"*.

We follow this approach when interpreting our results. The phenomenon we are studying is very complex. Our simple model is not able to control for the all the differences between countries and bank crises. For example, we do not distinguish between severe and mild crises. This is because we lack a good proxy. Initially we attempted to use the peak NPL ratio, but this metric is not harmonized both across countries and in time.[16] We also do not control for some other confounding factors, including the presence of liquidity assistance and state guarantees. We assumed the effect of them on medium-term economic growth is negligible. The effect of new resolution mechanisms such as bail-ins is also not considered. For these reasons our primary concern is to identify the signs of dummy variable coefficients. We also report their magnitudes, but we believe those are less relevant. Our hypotheses reflect this, since they focus only on the signs of dummy coefficients.

The discussion above emphasizes the need for a careful interpretation of results. They

[16]The peak NPL data is hard to obtain for some crises.

do not necessarily imply causal relationships, nor are they able to credibly establish the magnitudes of effects of certain variables on GDP growth. For instance, if we find that μ is -0.60 % that does not necessarily mean that the average effect of bailouts is to decrease the medium-term GDP growth by -0.60 % per year. This result should be interpreted as a stylized fact, which tells us: (a) the effect of bailouts on growth is negative, (b) this effect is likely non-negligible.[17] We explicitly refrain from making any policy recommendations based on our results. This is because much more empirical support is needed. Additionally, the analysis aiming to provide policy recommendations should consider the short, medium- and long-term effects of bailouts. Even if medium-term effects are negative for growth, the short- and long-term effects could be so positive so that bailouts would nevertheless be desirable.

3.3 Estimation with SUR

We will estimate the coefficients of the family of models (Equation 2) using the seemingly unrelated regression (SUR) estimator, developed by Zellner (1962). Many growth regression studies use SUR (Fisher, 1991; Kagan, 2012) or the closely related three-square-least stage (3SLS) estimator (Barro, 1996; Berthold & Gründler, 2012). The 3SLS estimator was developed by Zellner and Theil (1962) and is equivalent to combining SUR with instrumental variables.[18] Because we believe our covariate construction can address the variable endogeneity, we use the SUR estimation, rather than 3SLS. As shown in the model (Equation 2) we impose homogeneity restrictions on the coefficients. For this reason, we will refer to our estimation as pooled SUR.

The main advantage of pooled SUR over a pooled OLS estimator is that the former allows errors to be correlated between periods (so called contemporaneous correlation). This means that errors for a single country can be correlated between periods. This correlation is the same for all countries in the sample and is present only within countries. In other words, SUR does not allow the errors of two different countries to be correlated, neither contemporaneously nor in any other way.

Put more formally the SUR estimator assumes that:

$$E(u_i \cdot u_i' | X) = \Sigma, \text{ where } \Sigma \in \mathbb{R}^{\text{T x T}}$$

$$E(u_i \cdot u_j' | X) = 0, \text{ when } i \neq j$$

This means that the covariance matrix of error:

$$E(u \cdot u' | X) = \Omega, \text{ where } \Omega \in \mathbb{R}^{\text{NT x NT}}$$

[17] The value of μ in this section is made up and used for illustration purposes only.
[18] Instruments are often lagged values of covariates (Barro, 2003).

can be written as:[19]

$$\Omega = \Sigma \otimes I_N$$

where $I_N \in \mathbb{R}^{\mathrm{N\ x\ N}}$ is the identity matrix.

The main challenge with SUR is to estimate the variance covariance matrix $\hat{\Sigma}$. The standard way of estimating the SUR coefficient is to first apply the OLS estimator to the system (to each equation separately):[20]

$$\hat{\Theta}_{OLS}(m) = (X^{'}(m) \cdot X(m))^{-1} \cdot (X^{'}(m) \cdot y)$$

The residuals $\hat{u}_i$ are used to estimate $\hat{\Sigma}$:

$$\hat{\Sigma} = \frac{1}{41} \sum_{i=1}^{41} \hat{u}_i \hat{u}_i'$$

After $\hat{\Sigma}$ is estimated we use feasible generalized least squares (fGLS) to estimate the coefficients in the model (Henningsen & Hamann, 2007; Moon & Perron, 2018):

$$\hat{\Theta}(m)_{FGLS} = (X^{'}(m) \cdot (\hat{\Sigma}^{-1} \otimes I_N) \cdot X(m))^{-1} \cdot (X^{'}(m) \cdot (\hat{\Sigma}^{-1} \otimes I_N) \cdot y)$$

The procedure above is used when SUR coefficients are not pooled. When pooling occurs, the regressor matrix $X(m)$ needs to be adjusted. For details of required adjustments see Henningsen and Hamann (2007, p.7-8).

4 DATA

4.1 Country selection

Earlier it was argued that groups of countries on different continents or at different developmental stages may follow different growth models. To minimize the potential distortions this could cause, we include only developed countries in our sample. Altogether we include 41 countries, all the European Union (EU) countries, except Croatia,[21] and thirteen other member countries of Organization for Economic Development and Cooperation (OECD). The list of countries is presented in Table 2.

[19]The symbol $\otimes$ denotes the Kronecker product. Suppose we have matrices $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and B, the Kronecker product $A \otimes B$ is defined as $\begin{bmatrix} a \cdot B & b \cdot B \\ c \cdot B & d \cdot B \end{bmatrix}$.

[20]We use the R's Systemfit package to obtain the coefficient estimates (Henningsen & Hamann, 2007).

[21]Croatia is excluded from the sample, due to some missing data.

Table 2: Countries included in the sample.

Australia	Austria	Belgium	Bulgaria	Canada	~~Croatia~~
Chile	Czech Republic	Cyprus	Denmark	Estonia	Finland
France	Germany	Greece	Hungary	Iceland	Ireland
Israel	Italy	Japan	South Korea	Latvia	Lithuania
Luxembourg	Malta	Mexico	Netherlands	New Zealand	Norway
Poland	Portugal	Romania	Singapore	Slovak Republic	Slovenia
Spain	Sweden	Switzerland	Turkey	United Kingdom	United States

Source: own work.

Growth regressions are used to explain average growth rates over longer time intervals. Most studies use at least twenty years of data (recall Table 1). Many countries in our dataset became independent only in the early 1990s. For most of them it is hard to obtain data from before 1992. Data on bank crises and bailouts is available only until 2015, which means we have twenty-three years of available data (1992-2015). By using five-year intervals, we split the sample into four periods: 1995-99, 2000-04, 2005-09 and 2010-14. We start with year 1995, not 1992, because some covariates are constructed in a way that requires their values before the period starts. For example, a covariate value from 1994 may be used in the 1995-99 period. The following section explains the covariate construction in details.

4.2 Covariate selection and construction

Our model uses ten independent variables or covariates (see Table 3). They were selected based on their popularity and statistical significance in previous in the growth regression studies (see the Table 7 at the end of this section).

Table 3: The set of chosen covariates.

GDP/capita	Primary education attainment	Tertiary education attainment
Female fertility rate	Dependency ratio (old)	Capital formation [22]
Openness [23]	Rule of law	Deposits/GDP
Government debt/GDP		

Source: own work.

All variables in growth regressions are likely endogenous. To address the endogeneity in the model, we use the covariate values from an earlier period. See Table 5 (at the end of this section) for details. The raw data is presented in Table 23 in Appendix 2.

[22]Investment/GDP

[23](Exports + Imports)/GDP

Next we explain the definitions and sources for bank crises and bailout data.

The literature identifies at least three approaches for defining bank crises:

- Reinhart and Rogoff (2009, p.11) identify bank crises either by bank runs or by *"the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions)"*.

- Laeven and Valencia (2018, p.4) use a similar approach as Reinhart and Rogoff. They identify bank crises based on the presence of financial distress *"as indicated by significant bank runs, losses in the banking system, and/or bank liquidations"*. Additionally, one of the following criterion must be fulfilled: (a) NPLs must exceed 20% of assets or at least 20% of the banking system must be liquidated, (b) the government intervenes with at least three different policy measures.[24]

- Baron, Verner and Xiong (2018, p.4) use bank stock index data to identify potential crises. When the index declines by at least 30% and *"there is an abundance of narrative evidence consistent with a banking crisis (featuring historical evidence of widespread bank failures or bank runs)"* a bank crises is identified.

We use the recently updated database of Laeven and Valencia (2018) as the basis for determining bank crises and bailout cost.[25] There are several reasons for this: (a) the database includes all the countries in our sample, (b) the data on fiscal costs is available for most crises, (c) end dates for most bank crises are identified.[26] Fiscal cost are defined as: *"fiscal outlays directly related to government intervention measures in the financial sector"* (Laeven & Valencia, 2018, p.3). This definition covers both recapitalizations and (bad) asset purchases and is in line with our definition of bailouts.

Ending dates and fiscal costs for some crises are not available. An example includes the Italian crisis that started in 2011. In this and other such cases, alternative literature sources are consulted to fill the gaps. The main source is the European Commission's (EC) state aid scorecard (2017) which covers various forms of state assistance to financial institutions (see Table 6 for data on recapitalizations). We set the crisis ending in the year of the final fiscal outlay by the government, provided that the following two years there was no additional government help for financial institutions.[27] Laeven and

[24]The measures considered are bank holidays, bank nationalizations, cost of bank bailouts, liquidity support, guarantees and assets purchases.

[25]Due to the lack of data on fiscal cost, we do not include the 1990-5 bank crisis in Italy and the 1991 crisis in Switzerland and the 1993 crisis in Iceland. All these crises are identified as "borderline cases".

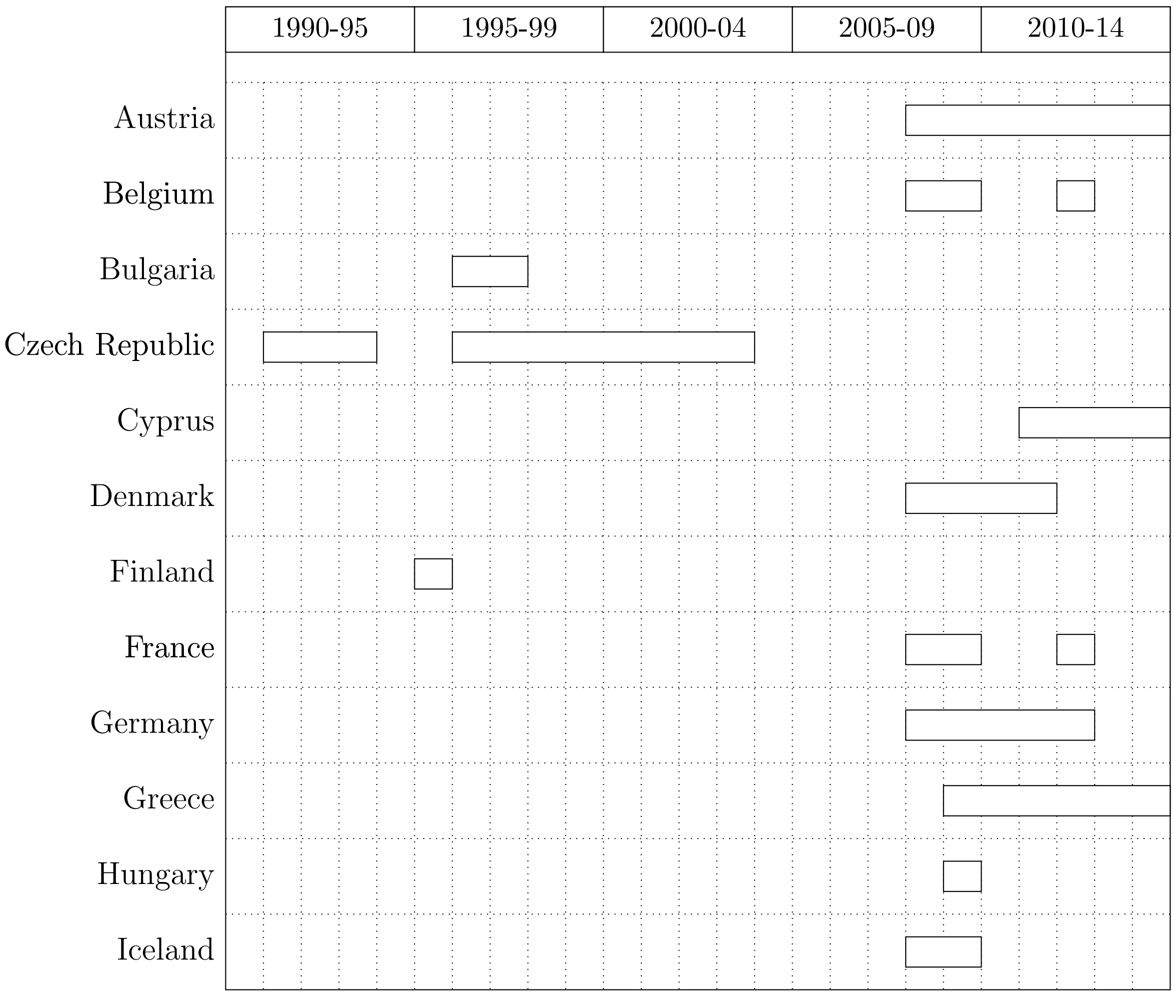
[26]The end date of the crisis is: *"defined as the year before both real GDP growth and real credit growth are positive for at least two consecutive years"*(Laeven & Valencia, 2018, p.21).

[27]We also joined successive bank crises which were a year apart. But we did not identify any new ones.

Valencia automatically limit the duration of crises to five-years, we correct for this by applying the aforementioned methodology. For crises outside the scope of the state aid scorecard, we use additional sources.[28]

Finally, we modify the fiscal cost of the crisis in the European Union between 2008 and 2014 to match the reported values in the scorecard. We consider the scorecard data to be of higher quality. In most cases the estimated fiscal costs are similar. For instance, the cost of 2008-2014 bank crises in Austria amounted to 5.2% GDP based on Laeven data and 4.1% of GDP based on EC data. We present the identified bank crises in Table 4.

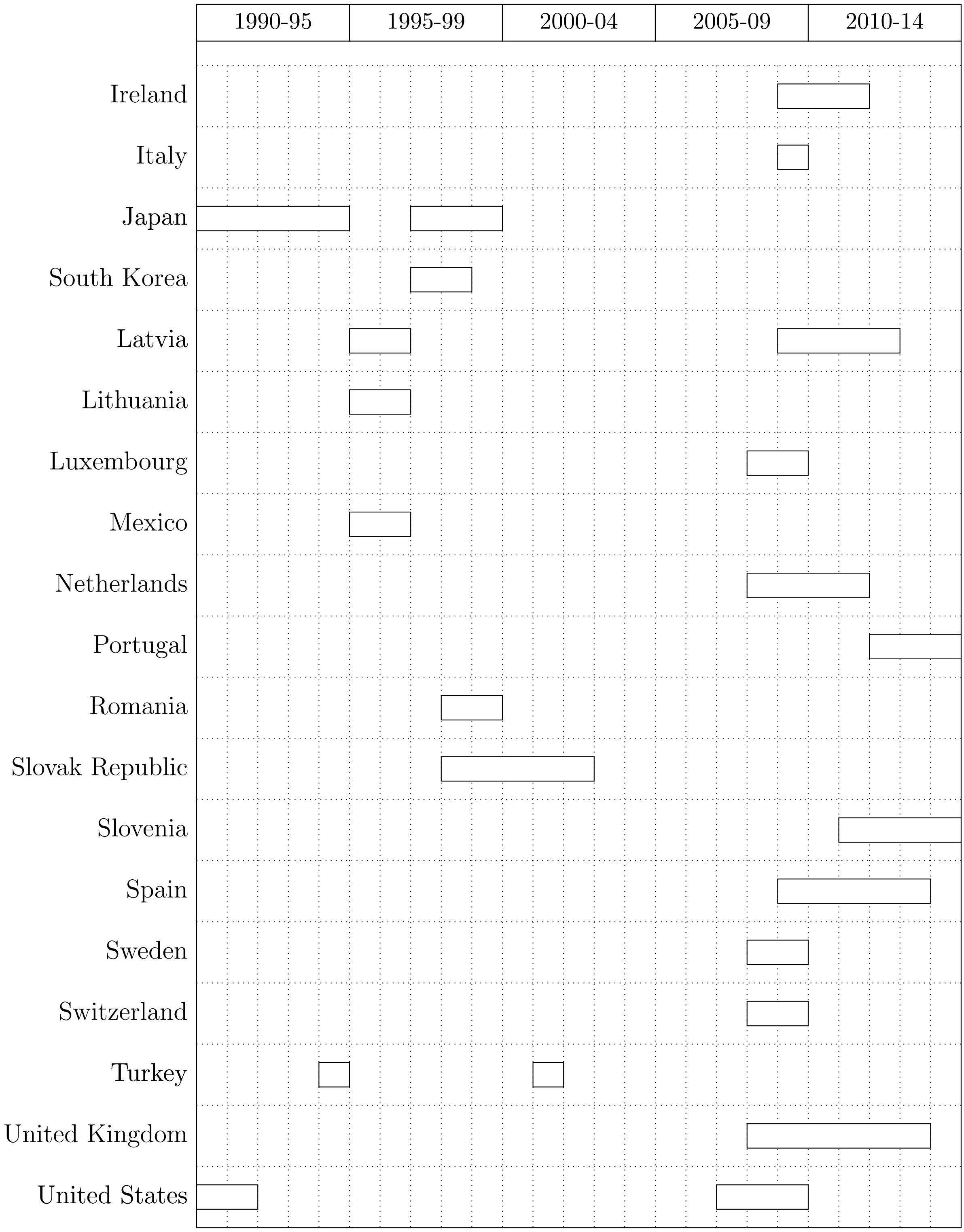
Table 4: Banking crises in the sample.



Continued on the next page.

[28]See Barta and Singer (2006) and Tang, Zoli and Klytchnikova (2000) for data on the Czech crisis in 1990s, IMF (1998) and Honohan and Klingebiel (2000) for fiscal costs of crises in Turkey, US and Japan in the 1990s.

Table 4: Banking crises in the sample (cont.).



Source: own work and Laeven and Valencia (2018), European Commission's (EC) state aid scorecard (2017), Barta and Singer (2006), Tang, Zoli and Klytchnikova (2000), IMF (1998), Honohan and Klingebiel (2000).

Table 5: Covariate construction details and the data sources used. Note: The f(x) column denotes the functions that was applied to a covariate. ln refers to the natural logarithm. Note 2: When constructing the covariate values for the 1995-1999 period, we use the data from 1992 when data from the start of the previous period is needed. When the average value over the previous period is needed, we use the average data between 1992-1994. The same logic applies to the construction of dummy variables $D^2_{i,t}$ and $D^3_{i,t}$ for the first period.

Variable	**f(x)**	**Construction**	**Data source**
GDP growth	/	Average GDP growth over the period.	World Bank Open Data
GDP per capita	ln	Value from the start of the period before e.g. for period starting in 2000, the value from 1995 is used.	World Bank Open Data
Primary education attainment	/	Value from the start of the period e.g. for period starting in 2000, the value from 2000 is used.	Barro - Lee dataset (Barro & Lee, 2013)
Tertiary education attainment	/	Same as primary education attainment.	Barro - Lee dataset
Female fertility (total)	ln	Same as GDP per capita.	World Bank Open Data
Dependency ratio (old)	ln	Same as primary education attainment.	World Bank Open Data
Capital formation	/	Average of one period before e.g. for the period starting in 2000, the value is the average of 1995-9 period.	World Bank Open Data
Openness (Trade to GDP)	/	Same as age dependency ratio.	World Bank Open Data
Deposits to GDP	/	Same as primary education attainment.	IMF, Historical public debt (HPDD)
Government debt to GDP	/	Same as primary education attainment.	World Bank Open Data & FRED
Rule of law	/	Same as primary education attainment.	Freedom house, freedom in the world report

Source: own work.

Table 6: Bank recapitalization amounts in the EU between 2008 and 2014. They are expressed as a % of GDP. Note: the shaded countries did not spend any taxpayer funds on bank bailouts.

Member State	2008	2009	2010	2011	2012	2013	2014	Total
Belgium	4.1%	1.0%	0.0%	0.0%	0.75%	0.0%	0.0%	**5.8%**
Bulgaria	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Czech Republic	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Denmark	0.2%	3.5%	0.8%	0.1%	0.0%	0.0%	0.0%	**4.6%**
Germany	0.8%	1.3%	0.3%	0.1%	0.0%	0.0%	0.0%	**2.6%**
Estonia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Ireland	0.0%	6.5%	21.0%	9.6%	0.0%	0.0%	0.0%	**37.1%**
Greece	0.0%	1.6%	0.0%	1.3%	16.2%	2.0%	0.0%	**21.0%**
Spain	0.0%	0.1%	0.9%	0.8%	3.9%	0.2%	0.0%	**5.9%**
France	0.7%	0.5%	0.0%	0.0%	0.1%	0.0%	0.0%	**1.3%**
Croatia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Italy	0.0%	0.3%	0.0%	0.0%	0.1%	0.1%	0.0%	**0.5%**
Cyprus	0.0%	0.0%	0.0%	0.0%	9.2%	0.0%	8.5%	**16.7%**
Latvia	0.0%	2.2%	0.6%	0.0%	0.2%	0.0%	0.0%	**2.9%**
Lithuania	0.0%	0.0%	0.0%	0.01%	0.0%	0.7%	0.1%	**0.8%**
Luxembourg	6.6%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	**6.8%**
Hungary	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
Malta	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Netherlands	2.2%	0.0%	0.8%	0.0%	0.0%	0.6%	0.0%	**3.6%**
Austria	0.3%	2.1%	0.2%	0.0%	0.6%	0.5%	0.2%	**3.9%**
Poland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Portugal	0.0%	0.0%	0.0%	0.0%	4.0%	0.7%	2.8%	**7.5%**
Romania	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Slovenia	0.0%	0.0%	0.0%	0.7%	1.3%	6.7%	1.2%	**9.9%**
Slovakia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Finland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.0%**
Sweden	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
United Kingdom	2.5%	0.6%	1.9%	0.2%	0.0%	0.2%	0.0%	**5.3%**

Source: European Commission's state aid scorecard (2017).

Table 7: Covariate choice was informed by the existing literature. *Note, the literature cited under bank deposits/GDP discusses the effect of financial development of GDP growth. Use of bank deposits is not a common way of capturing financial development. However, we think that to properly estimate the effect of bank bailouts on economic growth, the size of the banking system needs to be controlled for.*

Literature review of covariates used
GDP/capita, *Literature:* (Barro, 2003), (Bassanini & Scarpetta, 2001), (Sala-i-Martin et al., 2004), (Gadea Rivas & Sanz Villarroya, 2017), (Higgins, Young & Levy, 2008), (Levine & Renelt, 1992)
Primary edu. attainment, *Literature:* (Sala-i-Martin et al., 2004), (Barro, 2003), (Mankiw et al., 1992), (Cooray, 1992), (Bassanini & Scarpetta, 2001), (Higgins et al., 2008)
Tertiary edu. attainment, *Literature:* Same as above
Female fertility rate, *Literature:* (Barro, 2003), (Fox, Klüsener & Myrskylä, 2018)
Dependency ratio (old), *Literature:* (Santacreu, 2016), (Herzog, 2011), (Fayissa & Gutema, 2010), (Brendan & Sek, 2016)
Capital formation, [29] *Literature:* (Barro, 2003), (Bassanini & Scarpetta, 2001), (Sala-i-Martin et al., 2004), (Levine & Renelt, 1992), (Gylfason & Zoega, 2006)
Openness, [30] *Literature:* (Barro, 1996), (Barro, 2003), (Bassanini & Scarpetta, 2001), (Levine & Renelt, 1992), (Fetahi-Vehapi, Sadiku & Petkovski, 2015), (Rodríguez, 2006)
Rule of law, *Literature:* (Barro, 2003), (Ozpolat, Guven, Ozsoy & Bahar, 2016), (Mahoney, 2015), (Barro, 1996), (Sala-i-Martin et al., 2004)
Government debt/GDP, *Literature:* (Reinhart & Rogoff, 2010), (Herndon, Ash & Pollin, 2014)
Bank deposits/GDP, *Literature:* (Bassanini & Scarpetta, 2001), (Petkovski & Kjosevski, 2014), (Levine & Zervos, 1993)

Source: own work.

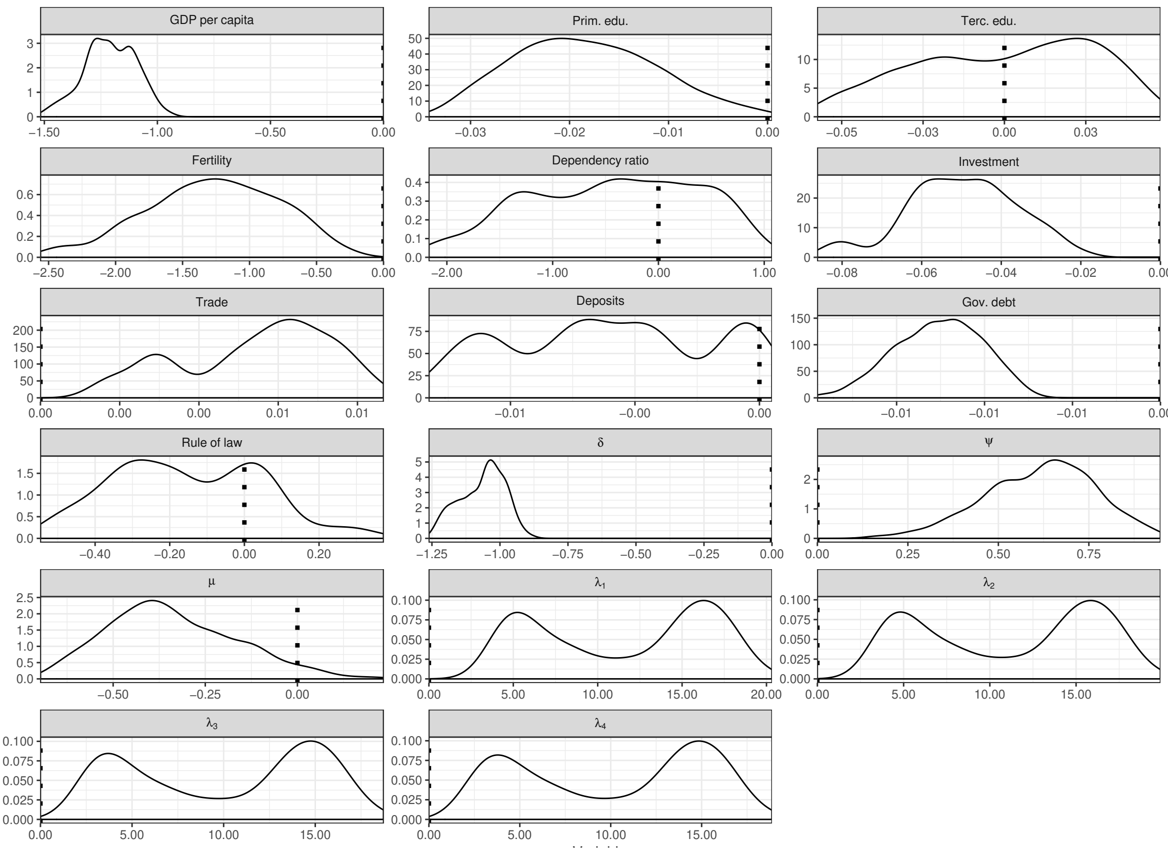
5 RESULTS AND DISCUSSION

In this section we present and discuss the results. Additionally, we perform three robustness tests. They consist of (a) redefining the bailout dummy $D^3_{i,t}$ from being binary to capturing the size of the bailout in percentage of GDP, (b) estimating the coefficients using pooled OLS to see the efficiency improvement of the SUR estimator and (c) re-estimating the coefficients for the subset of models with highest AIC and BIC weights, using non-pooled SUR to test whether the coefficients values are indeed the same in all periods.

5.1 Basic specification results

We estimate 1024 models using the SUR estimator and restrict the coefficient values to be the same across all countries and periods. We show the probability density functions of raw[31] coefficient estimates (see Figure 1) and their summary statistics (see Table 8).

Figure 1: Probability density function of coefficient estimates (basic specification). Note: we draw a dotted line at zero to highlight the signs of the estimates.



Source: own work.

[31]By raw estimates, we mean that no weighting scheme is applied to the data.

Table 8: Descriptive statistics of the coefficient estimates (basic specification). Note: the values are rounded to two decimal places.

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
GDP per capita	-1.50	-1.30	-1.20	-1.20	-1.10	-0.93
Prim. edu.	-0.03	-0.02	-0.02	-0.02	-0.01	0.00
Terc. edu.	-0.06	-0.02	0.00	0.00	0.02	0.05
Fertility	-2.60	-1.60	-1.30	-1.30	-0.90	-0.20
Dependency ratio	-2.20	-1.10	-0.39	-0.43	0.23	1.10
Investment	-0.09	-0.06	-0.05	-0.05	-0.04	-0.02
Trade	0.00	0.00	0.01	0.01	0.01	0.01
Deposits	-0.01	-0.01	-0.01	-0.01	-0.00	0.00
Gov. debt	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
Rule of law	-0.55	-0.30	-0.17	-0.15	0.01	0.37
δ	-1.30	-1.10	-1.10	-1.10	-1.00	-0.87
ψ	0.14	0.51	0.63	0.62	0.73	0.95
μ	-0.70	-0.47	-0.36	-0.34	-0.22	0.23
λ_1	3.20	6.20	13.00	12.00	16.00	20.00
λ_2	2.80	5.80	13.00	11.00	16.00	20.00
λ_3	1.60	4.60	11.00	10.00	15.00	19.00
λ_4	1.50	4.80	12.00	10.00	15.00	19.00

Source: own work.

For each of the coefficients we calculate the percentages of models where the estimated coefficient's sign is positive and negative. In cases where more than 95% of the model estimates take the same sign, a coefficient is said to have a statistically significant sign. We then compare the estimated signs with those in the literature (see Table 9).

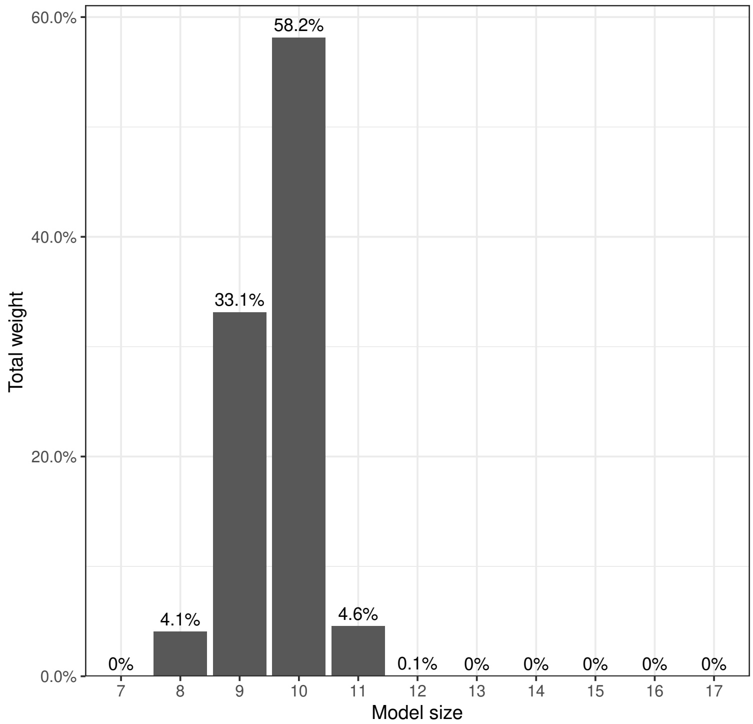
Table 9: Comparison of the estimated covariate coefficient signs with those in the literature.

Covariate	Literature	Model	Covariate	Literature	Model
GDP per capita	-	-	Rule of law	+	unclear
Prim. edu.	-	-	δ	-	-
Terc. edu.	+	unclear	ψ	+	+
Fertility	-	-	μ	unclear	-
Dependency ratio	-	unclear	λ_1		+
Investment	+	-	λ_2		+
Trade	+	+	λ_3		+
Deposits	unclear	-	λ_4		+
Gov. debt	-	-			

Source: own work.

We see that investment is the only covariate that is significant, but has the opposite sign than in the literature. Signs for: tertiary education attainment, dependency ration and rule of law are not significant. Next we calculate the model weights w_m based on the Akaike information criterion (AIC) and Bayesian information criterion (BIC).

Figure 2: Distribution of BIC weights by model size (basic specification).



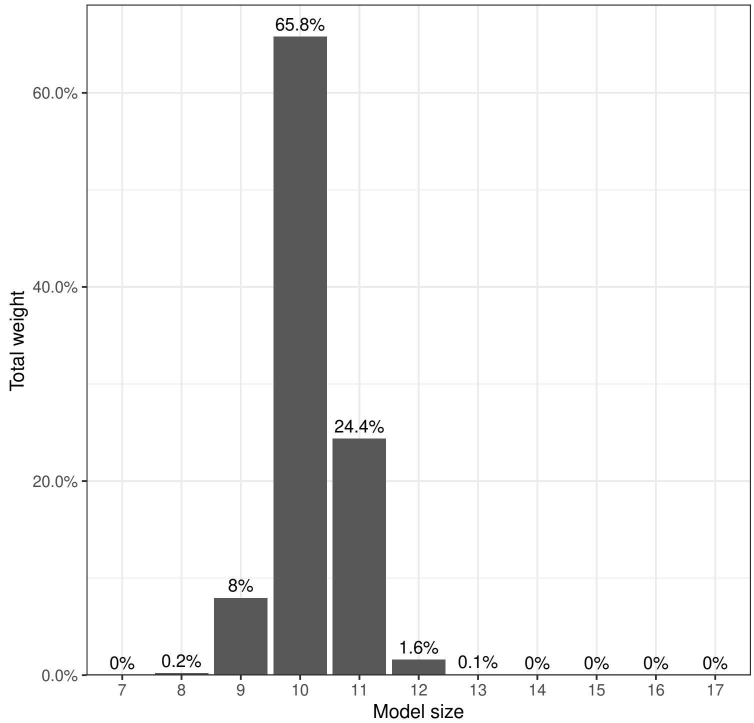
Source: own work.

When BIC is used to construct model weights, they tend to cluster among smaller models (see Figure 2). More than 90% of the weight is concentrated in the models with nine or ten variables. Each model has seven "protected" variables. This means that BIC favors models which have only two or three covariates.

When AIC is used, models are on average slightly larger (see Figure 3). About 90% of the weight lies with model that have ten or eleven variables. The most weight still lies in models with size ten (three covariate) models. It is expected that AIC models will be larger (have more covariates), because BIC penalizes larger models more heavily. This can be seen in equations 4 and 5 in section 3. AIC penalty term is $2\dim(\mathcal{M}_m)$ while BIC penalty term is $\ln(N)\dim(\mathcal{M}_m)$. Given that $N = 164$, the value of $\ln(N)$ is about 5.10. This means that BIC penalty term is roughly two and a half times larger than the AIC penalty. Hence, the AIC models are, on average, larger.

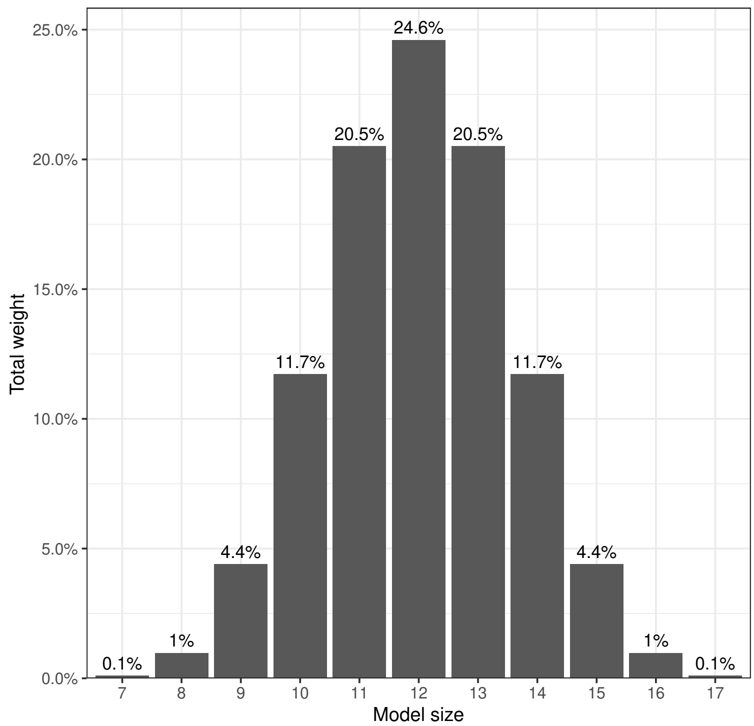
We also show the distribution of model weights when uniform (EWE) weighting is used (see Figure 4). In this case, 65% of the weight is spread among models with more than four covariates (model size is larger than eleven). This is expected, because the

Figure 3: Distribution of AIC weights by model size (basic specification).



Source: own work.

Figure 4: Distribution of uniform weights (EWE) by model size (basic specification).



Source: own work.

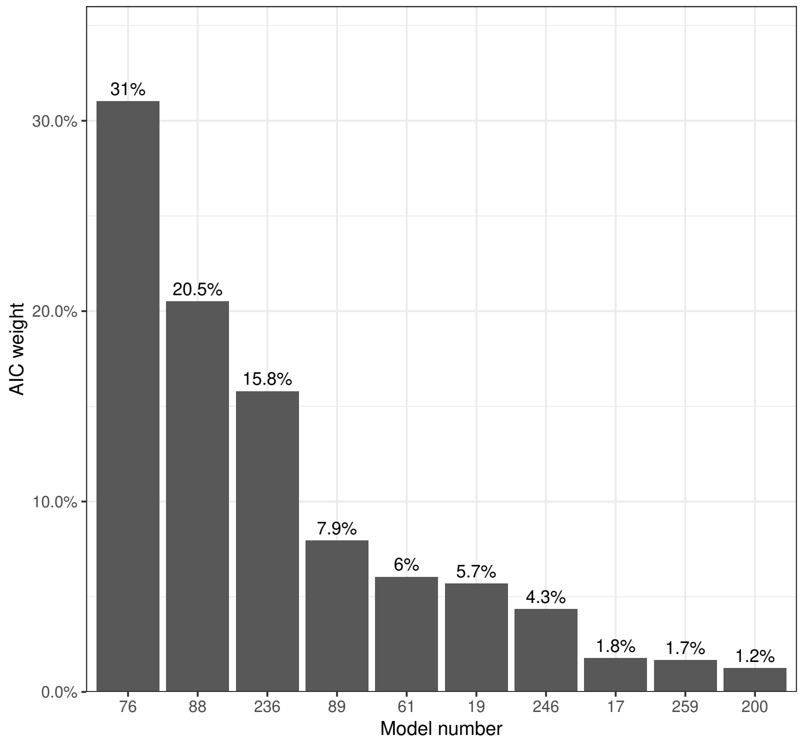
distribution of weights is determined by the number of unique models that include k out of ten covariates. The total weight of models which include k out of ten covariates can be computed as:[32]

$$\frac{1}{2^{10}} \cdot \binom{10}{k}$$

This function has a peak when $k = 5$ or when the model size is twelve. This is what we observe (see Figure 4).

When AIC and BIC weighting schemes are used, we see that model weights are concentrated among the models with two to four covariates. Next, we show the individuals models with the highest weights. When uniform weights are used each model has a weight of $w_m = 9.8 \cdot 10^{-4}$.[33] We use this as a reference value.

Figure 5: The ten models with the highest AIC weights (basic specification). Note: the model numbers have no special meaning and are used only to distinguish among the models.



Source: own work.

When examining individual AIC weights, we see that the majority of weight is concen-

[32] $\binom{a}{b} \equiv \frac{a!}{(a-b)! \cdot b!}$

[33] More precisely the weight is $w_m = \frac{1}{1024}$.

trated among a few models. For instance, the top ten models contribute about 96% of all the weight with 67% of the weight being contributed by the top three models (see Figure 5). We notice that all the models include the GDP per capita, four include trade, three include government debt, two include total female fertility and one includes primary education attainment and rule of law (see Table 10). It is worth noting that signs of all the covariates and dummies are stable across specifications. Additionally, comparing the sign to the literature (recall Table 9) all the signs of covariates and dummies are as expected. The rule of law variable normally has a positive sign in the literature, meaning that improvements in rule of law lead to higher GDP growth. Our model confirms this finding; however, the rule of law variable is constructed so that a higher variable value means less rule of law. Thus, the negative sign of the rule of law coefficient is consistent with the literature.

Table 10: Specification of five models with the highest AIC weight (basic specification).

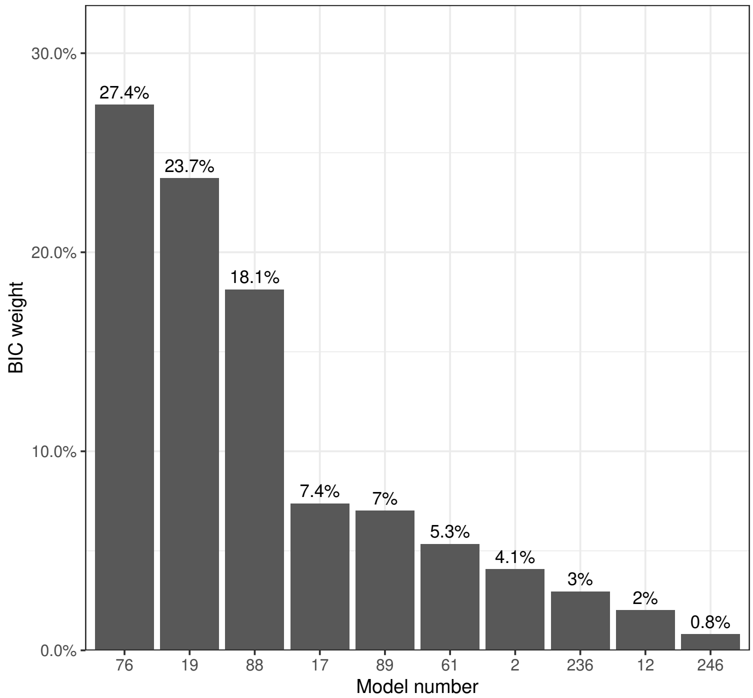
	76	88	236	89	61
AIC Weight	31 %	21 %	16 %	8 %	6 %
GDP per capita	-1	-1.1	-1.1	-1.4	-1.3
Prim. edu.					-0.027
Terc. edu.					
Fertility	-1.4		-1.2		
Dependency ratio					
Investment					
Trade		0.0044	0.0039	0.0063	0.0046
Deposits					
Gov. debt	-0.012	-0.0097	-0.011		
Rule of law				-0.46	
δ	-1	-1	-1	-0.98	-1
ψ	0.67	0.65	0.59	0.49	0.62
μ	-0.4	-0.32	-0.23	-0.21	-0.32
λ_1	15	14	15	17	16
λ_2	15	14	15	17	16
λ_3	14	13	14	16	15
λ_4	14	13	14	16	15

Source: own work.

When BIC weights are constructed, consolidation of model weights is even more obvious. The top ten models account for almost 99% of the weight, while the top three models contribute 69% (see Figure 6). The variables included in top five BIC models are very similar to AIC models. All the models include the GDP per capita, three models include trade and government debt, while total female fertility and rule of law appear in only once (see Table 11). Again, all the variable signs are stable and consistent with the finding in the literature. Three out of the five best models (76, 88 and

89) are shared between the AIC and BIC weighting schemes.

Figure 6: The ten models with the highest BIC weights (basic specification).



Source: own work.

Finally, we show the weighted coefficient estimates. Each variable is included in half (i.e. 512) of the models, so averaging can be done in two ways. The conditional averaging uses only the models where the variables is present. In contrast, the unconditional averaging uses all 1024 models. It assigns the coefficient value of zero to models where the variable is not included. On average this causes the values of the unconditional estimates to be closer to zero. For "protected" variables we can only perform the conditional averaging, because those variables are present in all the models.[34]

When looking at the results of conditional (see Table 12) and unconditional (see Table 13) averaging, we focus our attention on the stability of the coefficients. The coefficient is stable if all three weighting schemes give the same coefficient sign. When the coefficient is stable, we also compare its sign to the literature.

After the conditional averaging all the signs, except for dependency ratio are stable. We cannot draw conclusions about the stability of signs for trade and tertiary educational attainment, because some of their estimates are zero. The signs of variables with stable coefficients are generally the same as in the literature. The only exception

[34]We also show their values after unconditional averaging (Table 13), however those values are the same as the conditional estimates.

Table 11: Specification of five models with the highest BIC weight (basic specification).

	76	19	88	17	89
BIC Weight	27 %	24 %	18 %	7 %	7 %
GDP per capita	-1	-1	-1.1	-1.3	-1.4
Prim. edu.					
Terc. edu.					
Fertility	-1.4				
Dependency ratio					
Investment					
Trade			0.0044	0.0049	0.0063
Deposits					
Gov. debt	-0.012	-0.01	-0.0097		
Rule of law					-0.46
δ	-1	-1.1	-1	-1	-0.98
ψ	0.67	0.75	0.65	0.62	0.49
μ	-0.4	-0.53	-0.32	-0.33	-0.21
λ_1	15	14	14	15	17
λ_2	15	14	14	15	17
λ_3	14	13	13	14	16
λ_4	14	13	13	14	16

Source: own work.

Table 12: Results of conditional model averaging (basic specification).

	AIC weighted	BIC weighted	EWE weighted
GDP per capita	-1.10	-1.10	-1.20
Prim. edu.	-0.03	-0.03	-0.02
Terc. edu.	0.04	0.04	0.00
Fertility	-1.30	-1.40	-1.30
Dependency ratio	0.90	0.89	-0.43
Investment	-0.06	-0.05	-0.05
Trade	0.00	0.00	0.01
Deposits	-0.01	-0.01	-0.01
Gov. debt	-0.01	-0.01	-0.01
Rule of law	-0.44	-0.45	-0.15
δ	-1.00	-1.00	-1.10
ψ	0.64	0.67	0.62
μ	-0.34	-0.40	-0.34
λ_1	15.00	15.00	12.00
λ_2	15.00	15.00	11.00
λ_3	14.00	14.00	10.00
λ_4	14.00	14.00	10.00

Source: own work.

is the sign of investment which is negative.[35]

[35]We cannot make a literature comparison for the ψ and deposits to GDP variables. The reason

Table 13: Results of unconditional model averaging (basic specification).

	AIC weighted	BIC weighted	EWE weighted
GDP per capita	-1.10	-1.10	-0.60
Prim. edu.	-0.00	-0.00	-0.01
Terc. edu.	0.00	0.00	0.00
Fertility	-0.66	-0.42	-0.64
Dependency ratio	0.04	0.01	-0.22
Investment	-0.00	-0.00	-0.03
Trade	0.00	0.00	0.00
Deposits	-0.00	-0.00	-0.00
Gov. debt	-0.01	-0.01	-0.01
Rule of law	-0.04	-0.03	-0.08
δ	-1.00	-1.00	-1.10
ψ	0.64	0.67	0.62
μ	-0.34	-0.40	-0.34
λ_1	15.00	15.00	12.00
λ_2	15.00	15.00	11.00
λ_3	14.00	14.00	10.00
λ_4	14.00	14.00	10.00

Source: own work.

After the unconditional averaging, five coefficients have a zero value. Those are primary and tertiary education attainment, investment, trade and deposits. The coefficients of other variables and dummies (except for dependency ratio) are stable and have the expected signs.[36] After the unconditional averaging, the coefficient estimates based on AIC and BIC are generally smaller (except for GDP per capita). The unconditional EWE covariate coefficient estimates are exactly half the size of the conditional ones, which is expected.

5.2 Discussion and robustness tests

After reviewing the results of the basic specification, we can conclude that, after conditional averaging, most of covariate coefficient estimates have stable signs across weighting schemes. Their signs are the same as in the literature. This does not mean they are "correct", but it gives us additional confidence in our results. Turning to the dummy coefficients δ, ψ, μ, we find that their values and signs are stable across different model averaging schemes.

for this is the lack of agreement or studies on the matter.

[36]The values of δ, ψ, μ are the same in both cases. They are present in all the models so they cannot be weighted unconditionally.

The results of the basic specification confirm all three hypotheses (as shown below):

- H_1: The medium-term GDP growth of countries which had a bank crisis and bailed out banks is lower than the growth of countries which had a bank crisis but did not bail out banks i.e. $\mu<0$. On average the bailouts decrease growth by 0.34% - 0.40% a year.
- H_2: The medium-term GDP growth of countries which had a bank crisis is higher than for countries that did not have a bank crisis $\psi>0$. On average this effect adds 0.62% - 0.67% to growth per year.
- H_3: Bank crises have a negative impact on short-term GDP growth $\delta<0$. On average the growth rate decreases by 1.0% - 1.1% per year.

To gain further confidence in our results, we will perform three robustness checks: (a) re-running the same model, but with non-binary bailout dummy $D^3_{i,t}$, (b) estimating the model using pooled OLS instead of pooled SUR and (c) testing whether the assumption of coefficient homogeneity is reasonable.

5.2.1 Robustness test 1: Using a non-binary bailout dummy $D^3_{i,t}$

We re-estimate the same model as before, but this time $D^3_{i,t}$ is no longer a binary dummy. Instead it captures the percentage of GDP the country spent on bank bailouts. In other words:

$$D^3_{i,t} = \begin{cases} \text{A}, & \text{if in country } i \text{ in period } t-1\text{, there was a bank crisis and a bailout.} \\ 0, & \text{otherwise.} \end{cases}$$

where A is the total bailout cost in the period $t-1$ as a percent of GDP. We again show the models with highest AIC (see Table 14) and BIC weights (see Table 15). Their weights change, but in the AIC case, four out of five top models (88, 76, 236 and 89) remain the same as in the basic specification.[37] The models with the highest BIC weights are the same as in the basic specification. Furthermore, the signs and magnitude of coefficient estimates remain largely unchanged. The largest change we notice is that the coefficient of $D^3_{i,t}$ is much smaller than before. This is to be expected because the interpretation of this coefficient changes. Instead of measuring the effect of an average bailout (7.44 % of GDP) we measure the effect of bailout of the size of one percentage point of GDP. But, even if we correct for this, the effect of $D^3_{i,t}$ for the average bailout is smaller -0.0744%[38] instead of -0.34% in the basic specification. We also see that the ψ slightly decreases, while δ slightly increases.

[37]The model that switches is the one with the lowest weight.

[38]Calculated as $7.44\% \cdot -0.01 = -0.0744\%$.

Table 14: Specification of five models with the highest AIC weight (robustness test 1).

	88	76	236	89	19
AIC Weight	28 %	27 %	15 %	8 %	7 %
GDP per capita	-1.1	-1	-1.1	-1.4	-1
Prim. edu.					
Terc. edu.					
Fertility		-1.4	-1.2		
Dependency ratio					
Investment					
Trade	0.0045		0.004	0.0063	
Deposits					
Gov. debt	-0.0097	-0.012	-0.011		-0.01
Rule of law				-0.45	
δ	-1.1	-1.1	-1	-1	-1.1
ψ	0.5	0.44	0.46	0.39	0.47
μ	-0.015	-0.012	-0.0077	-0.0084	-0.02
λ_1	14	15	15	17	14
λ_2	14	15	15	17	14
λ_3	13	14	14	16	13
λ_4	13	14	14	16	13

Source: own work.

Table 15: Specification of five models with the highest BIC weight (robustness test 1).

	19	88	76	17	89
BIC Weight	26 %	22 %	22 %	9 %	7 %
GDP per capita	-1	-1.1	-1	-1.3	-1.4
Prim. edu.					
Terc. edu.					
Fertility			-1.4		
Dependency ratio					
Investment					
Trade		0.0045		0.0049	0.0063
Deposits					
Gov. debt	-0.01	-0.0097	-0.012		
Rule of law					-0.45
δ	-1.1	-1.1	-1.1	-1.1	-1
ψ	0.47	0.5	0.44	0.45	0.39
μ	-0.02	-0.015	-0.012	-0.014	-0.0084
λ_1	14	14	15	15	17
λ_2	14	14	15	15	17
λ_3	13	13	14	14	16
λ_4	13	13	14	14	16

Source: own work.

The robustness test supports the hypotheses H_0, H_1 and H_2, however the effect alternative model shows a much smaller effect of bailouts on medium-term economic growth (even after accounting for the different interpretation of results).

Table 16: Results of conditional model averaging (robustness test 1).

	AIC weighted	BIC weighted	EWE weighted
GDP per capita	-1.10	-1.10	-1.20
Prim. edu.	-0.03	-0.03	-0.02
Terc. edu.	0.04	0.04	-0.00
Fertility	-1.30	-1.40	-1.30
Dependency ratio	0.88	0.88	-0.45
Investment	-0.05	-0.05	-0.05
Trade	0.00	0.00	0.01
Deposits	-0.01	-0.01	-0.01
Gov. debt	-0.01	-0.01	-0.01
Rule of law	-0.44	-0.45	-0.16
δ	-1.10	-1.10	-1.10
ψ	0.45	0.45	0.37
μ	-0.01	-0.01	-0.00
λ_1	15.00	15.00	12.00
λ_2	15.00	15.00	11.00
λ_3	14.00	14.00	10.00
λ_4	14.00	14.00	10.00

Source: own work.

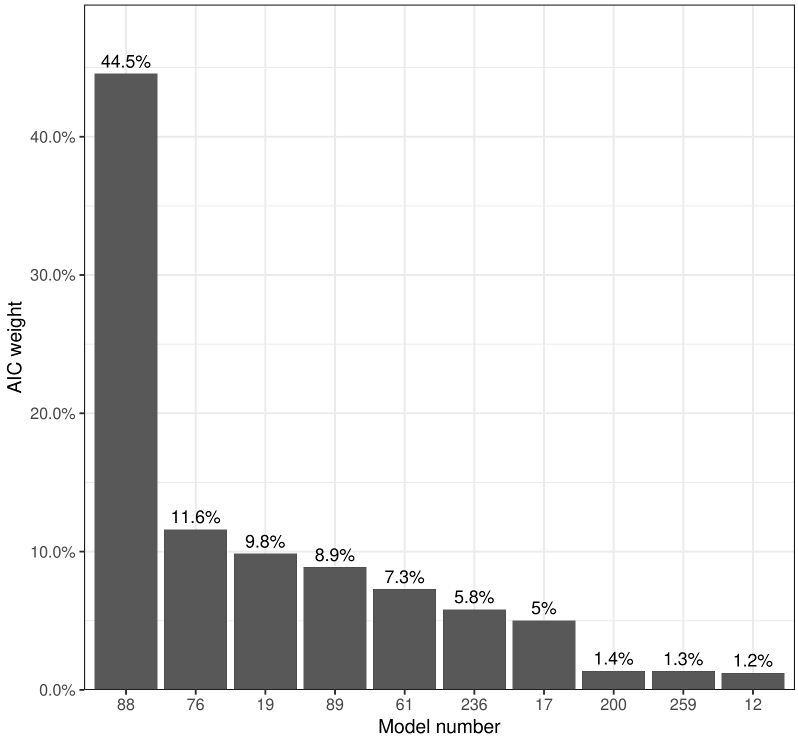
5.2.2 Robustness test 2: Estimation using pooled OLS estimator

We estimate also our basic specification using the pooled OLS estimator. This allows us to estimate the impact of using the SUR estimator on the results.

Looking at the models with the highest AIC weights (see Figure 7) we notice that three out of the five models (76, 89 and 61) are the same as in the basic specification. However, the distribution of weights changes. When we use the pooled OLS estimator, the top AIC model accounts for 44% of the weight, but the weights decay much faster than in the basic specification. Nevertheless, there is still a large concentration of weight with the top ten models accounting for 96% of the weight.

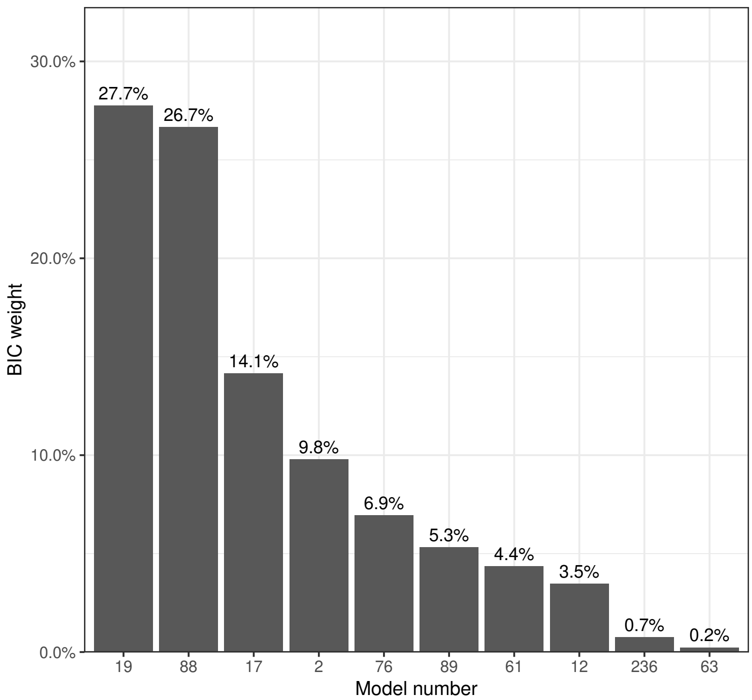
When looking at the distribution of BIC weights (see Figure 8) we see that top ten models more than 99% of the weight. The top two models have practically the same weight (around 27%). Four out of the five models (19, 88, 17 and 76) are the same as in the basic specification.

Figure 7: The ten models with the highest AIC weights (robustness test 2).



Source: own work.

Figure 8: The ten models with the highest BIC weights (robustness test 2).



Source: own work.

Table 17: Specification of five models with the highest AIC weight (robustness test 2).

	88	76	19	89	61
AIC Weight	45 %	12 %	10 %	9 %	7 %
GDP per capita	-1	-0.96	-0.99	-1.3	-1.2
Prim. edu.					-0.023
Terc. edu.					
Fertility		-1.2			
Dependency ratio					
Investment					
Trade	0.0049			0.0067	0.0051
Deposits					
Gov. debt	-0.011	-0.013	-0.012		
Rule of law				-0.37	
δ	-1.1	-1.2	-1.2	-1.1	-1.1
ψ	0.61	0.57	0.67	0.55	0.73
μ	-0.2	-0.19	-0.31	-0.18	-0.45
λ_1	14	14	14	17	15
λ_2	13	14	13	16	15
λ_3	12	13	13	15	14
λ_4	12	13	13	15	14

Source: own work.

The variables that appear in the top AIC models are the same as the ones in the basic specification (see Table 17). The coefficients signs are stable across models and match the literature. GDP per capita appears in every model with a negative sign. Trade and government debt appear in three models. Their signs are positive and negative respectively. Female fertility, rule of law and primary education attainment appear once and have negative signs. The dummy coefficients take the same signs and have similar values to the basic specification (μ is slightly smaller, δ and ψ are slightly larger).

The coefficients of top BIC models also have stable signs which are the same as in the literature (see Table 18). BIC models are, on average, smaller. The covariates are largely the same as in the basic specification. Except, the rule of law does not appear, while trade appear in two models (rather than three). The dummies take the same coefficient signs and have similar values to the basic specification (δ is slightly larger).

Looking at the weighted values of the coefficient (see Table 19) we notice that the dependency ratio has an unstable sign. The coefficient of investment is of the opposite sign as in the literature. The rest of the coefficients take the expected signs. The results are very similar as if they were estimated using the pooled SUR estimator. We can confirm our hypotheses H_1, H_2 and H_3.

Table 18: Specification of five models with the highest BIC weight (robustness test 2).

	19	88	17	2	76
BIC Weight	28 %	27 %	14 %	10 %	7 %
GDP per capita	-0.99	-1	-1.2	-1.2	-0.96
Prim. edu.					
Terc. edu.					
Fertility					-1.2
Dependency ratio					
Investment					
Trade		0.0049	0.0054		
Deposits					
Gov. debt	-0.012	-0.011			-0.013
Rule of law					
δ	-1.2	-1.1	-1.1	-1.2	-1.2
ψ	0.67	0.61	0.71	0.79	0.57
μ	-0.31	-0.2	-0.39	-0.55	-0.19
λ_1	14	14	15	15	14
λ_2	13	13	14	15	14
λ_3	13	12	13	14	13
λ_4	13	12	13	14	13

Source: own work.

Table 19: Results of conditional model averaging (robustness test 2).

	AIC weighted	BIC weighted	EWE weighted
GDP per capita	-1.10	-1.10	-1.10
Prim. edu.	-0.02	-0.02	-0.01
Terc. edu.	0.04	0.04	0.01
Fertility	-1.10	-1.10	-1.40
Dependency ratio	0.60	0.59	-0.49
Investment	-0.03	-0.02	-0.01
Trade	0.01	0.01	0.01
Deposits	-0.01	-0.01	-0.01
Gov. debt	-0.01	-0.01	-0.01
Rule of law	-0.36	-0.37	-0.05
δ	-1.10	-1.10	-1.20
ψ	0.62	0.67	0.67
μ	-0.23	-0.31	-0.23
λ_1	14.00	14.00	11.00
λ_2	14.00	14.00	10.00
λ_3	13.00	13.00	9.10
λ_4	13.00	13.00	9.10

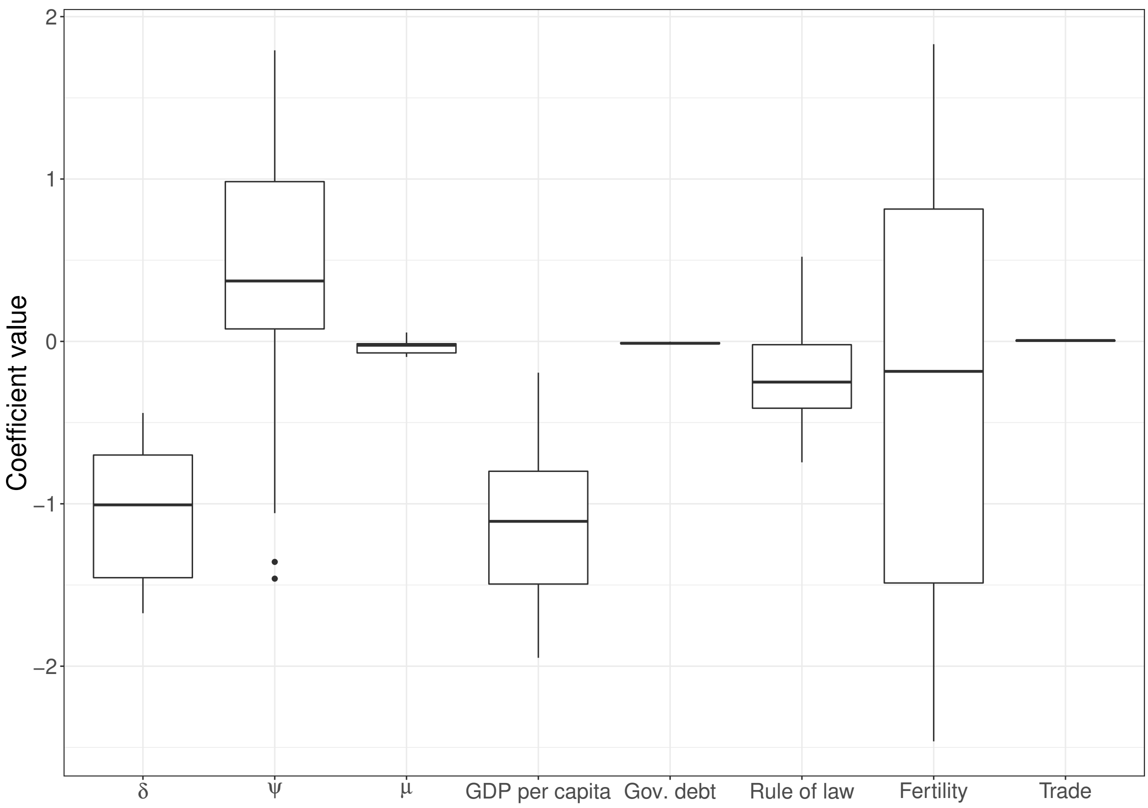
Source: own work.

5.2.3 Robustness test 3: Testing the homogeneity of coefficients

In growth regression literature it is commonly assumed that the econometric model explaining economic growth is time invariant. This means that covariate coefficients are restricted to take the same values in all periods. Imposing the coefficient homogeneity restriction seems reasonable, especially when short (five-year) periods are used. It safeguards against overfitting the model and minimizes the effect of noise in the data. Many variables in growth regressions are changing slowly (e.g. GDP per capita or dependency ratio), so we would not expect their effect on GDP growth to vary drastically between periods. Even if such behavior were observed, it would be difficult to explain it theoretically. For instance, how could one explain the coefficient of GDP per capita to go from - 1 to - 2 in the space of one period?[39] Nevertheless it is still worth performing a robustness check by re-estimating the top five AIC and BIC models using SUR. This time the coefficients are not restricted to be the same across periods.

We attempt to re-estimate the basic specification, however its unrestricted SUR estimate does not converge. For this reason, we re-estimate the model where $D^3_{i,t}$ takes non-binary values (robustness test 1). The models we are re-estimating are presented in Tables 14 and 15.

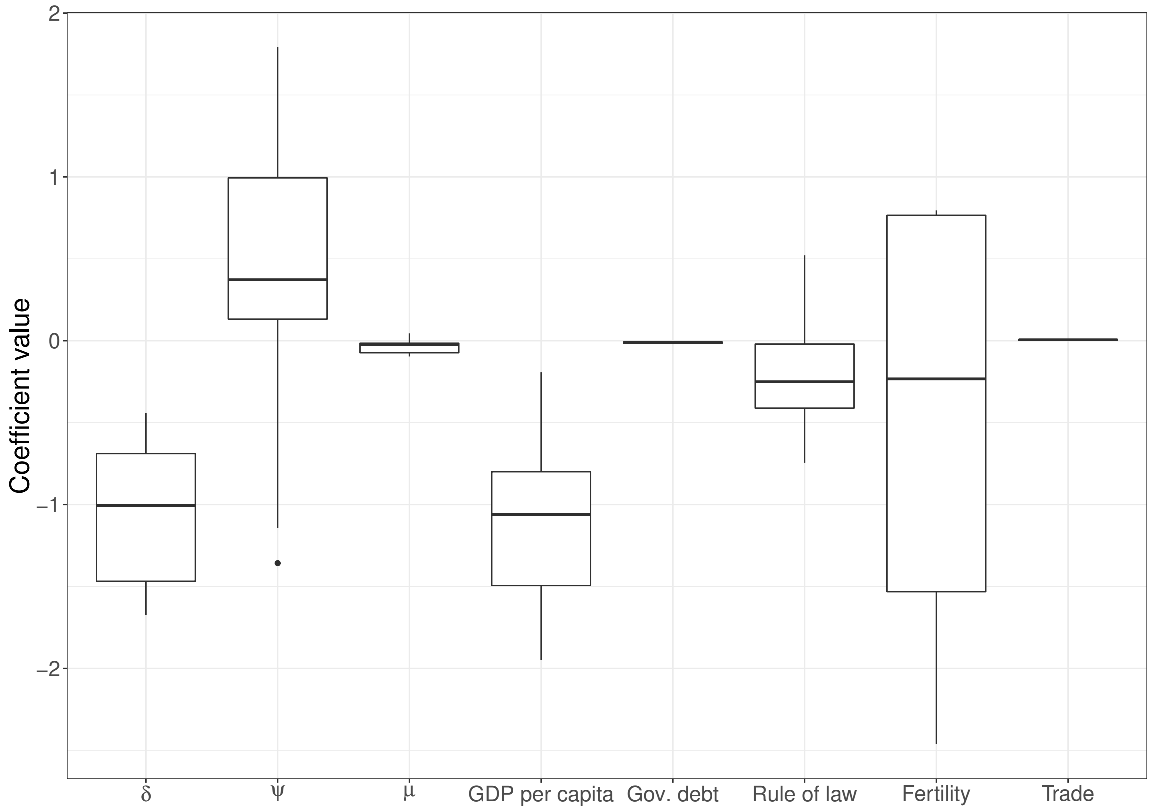
Figure 9: Box plot showing the variation of coefficient estimates for the five models with highest AIC weights. Estimation is using non-pooled SUR (robustness test 3).



Source: own work.

[39]Note that the example is fictional.

Figure 10: Box plot showing the variation of coefficient estimates for the five models with highest BIC weights. Estimation is using non-pooled SUR (robustness test 3).



Source: own work.

We show the distribution of the estimated coefficients for the top AIC and BIC models using box plots (see Figures 9 and 10). The coefficient distributions on both figures are similar, this is to be expected because four out of top five models (88, 76, 89 and 19) are common to both weighting schemes. We notice that signs of δ and GDP per capita are stable across specifications. They are always negative. Examination of the underlying data shows that the signs of trade and government debt are also stable across specifications. Their signs are positive and negative respectively. The signs of rule of law and fertility are unstable. The rest of covariates do not appear in the top AIC and BIC models. Turning to the remaining dummy coefficients μ and ψ, the sign of neither is significant at a 5% confidence level.[40] For both, AIC and BIC models, 3 out of 20 estimates of μ are positive (the rest are negative) and 5 out of 20 estimates of ψ are negative (the rest are positive).

By inspecting the distributions of coefficient estimates one may conclude that the values of coefficients are not the same in all periods. We formally test this assumption

[40] We also notice that the dispersion of ψ estimates is rather large compared to the other two dummy coefficient estimates.

Table 20: Results of F tests models with the highest AIC weight.

Model	SS_R	SS_U	q	$TN-l-1$	F	F_{crit}	Test
88	303	260	30	123	0.68	1.55	Cannot reject H_0
76	312	264	30	123	0.75	1.55	Cannot reject H_0
236	298	244	33	119	0.80	1.53	Cannot reject H_0
89	312	261	30	123	0.80	1.55	Cannot reject H_0
19	321	279	27	127	0.71	1.57	Cannot reject H_0

Source: own work.

using the F test. The test is applied to top AIC and BIC models separately. The results are presented in Tables 20 and 21. They show that the null hypothesis, that the coefficients are the same in all periods, cannot be rejected for any model at the 5% confidence interval.

Table 21: Results of F tests models with the highest BIC weight.

Model	SS_R	SS_U	q	$TN-l-1$	F	F_{crit}	Test
19	321	279	27	127	0.71	1.57	Cannot reject H_0
88	303	260	30	123	0.68	1.55	Cannot reject H_0
76	312	264	30	123	0.75	1.55	Cannot reject H_0
17	323	280	27	127	0.72	1.57	Cannot reject H_0
89	312	261	30	123	0.80	1.55	Cannot reject H_0

Source: own work.

From the perspective of the economic theory this is logical. It would be hard to argue that the high variability of some coefficients, e.g. fertility, could be explained by the real underlying changes in the world. The high variability of the estimates for different periods may be due to model overfitting. For our data set we cannot reject the assumption of coefficient homogeneity. Nor can we confirm it. This highlights the important role of untested assumptions in growth regressions.

CONCLUSION

The goal of this master's thesis is to estimate the effects of bank bailouts on medium-term economic growth. We want to test three hypotheses: (a) H_1: Does the presence of a bank crisis have a negative effect on the average GDP growth rate in that period, i.e. $\delta<0$? (b) H_2: Does the presence of a bank crisis in one five-year period have a positive effect on the average GDP growth rate in the following period, i.e. $\psi>0$? (c) H_3: Do countries that had a bank crisis in one five-year period and bailed out the banks have higher average GDP growth rates in the following periods than countries that had a crisis but did not bail out out the banks, i.e. μ<0 ?

We approach the research problem by augmenting a standard growth regression. Based on the existing research, we select ten macroeconomic variables or covariates to explain the GDP growth. We add the bailout and time period dummies to the model. We call these terms "protected" variables. We use bailout dummies to denote: (a) a contemporary bank crisis ($D^1_{i,t}$), (b) bank crisis in the previous period ($D^2_{i,t}$) and (c) bank crisis and bailout in the previous period ($D^3_{i,t}$). The dummies are binary, but as a part of the robustness tests we use a non-binary bailout variable ($D^3_{i,t}$). In the model we use data on 41 developed countries over the period of 20 years (1995-2014). To account for model uncertainty we estimate 1024 models (covering all the possible covariate combinations). The weight of an individual model is based either on the Akaike information criterion (AIC), Bayesian information criterion (BIC) or by assigning equal weights. The growth regressions are performed over five-year periods. To estimate the coefficients, we use the SUR estimator and restrict the covariate coefficients to be the same in all periods (equations). The SUR estimator allows for error terms for one country to be correlated across the periods. In the robustness analysis we also use the pooled OLS estimator and the SUR estimator without the restrictions (which allows the coefficients in all periods to be the same).

We find that the covariate signs are largely the same as in the literature. The only exception is investment which has a negative sign, rather than a positive one. This gives us some additional confidence in our model. The base model confirms hypotheses H_1, H_2 and H_3. The findings are robust over all the robustness tests, even when we perform a non-pooled SUR estimation of coefficients. In that case, despite the fact that coefficients' distributions suggest that the coefficients are different across periods, we cannot reject the null hypothesis that they are the same and so we confirm hypotheses H_1, H_2 and H_3.

Our findings regarding H_1 and H_2 replicate the existing literature. We also find that countries which had a bank crisis and did not bail out banks grew faster than those that did (H_3). It may be tempting to say that our findings support the view that banks should not be bailed out. However, such a conclusion would be too ambitious because the difference in GDP growth rates could be explained by other forms of state aid, which we did not control for, such as state guarantees, liquidity support or alternative measures like bail-ins. Also, there are likely other confounding factors that the model does not control for. For all these reasons we focus on identifying the signs, rather than the size of the effect. Our results do not necessarily imply causal relationships but should be interpreted as establishing some stylized facts. Much more empirical support is needed before these finding can be used to support policy recommendations.

Finally, when considering the desirability of bailouts also their effects on short- and the long-term growth need to be considered. It may be possible that while bailouts have a negative effect on medium-term growth, their effects on short-term growth is so positive that bailing out banks is still desirable.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

Uvod in pregled literature

V ekonomiji imajo banke pomembno vlogo. Rajan (1998) jim pripisuje dve glavni nalogi: zagotavljanje likvidnosti (tako za posojilojemalce kot za deponente) in financiranje kompleksnih finančnih pozicij (npr. kreditiranje manjših podjetji).[41] Motnje v delovanju bančnega sistema imajo negativne posledice za ekonomijo. Bernanke (1990) ter Baron, Verner in Xiong (2018) ugotavljajo, da so recesije, ki jih spremljajo bančne krize, daljše, povezane pa so tudi z višjimi proračunskimi primanjkljaji. Reševanje bank je zato nujno, tega se zavedajo tako bančni regulatorji kot politiki. Viceguverner norveške centralne banke je pred leti zelo nazorno opisal trenutno paradigmo reševanja bank. Dejal je, da danes ni več vprašanje, ali je reševanje bank potrebno, razčistiti je treba le, katere banke je treba rešiti.

Prepričanje, da je finančni sektor v času krize treba podpreti, ni novo. Država ima vsaj štiri različne vzvode za pomoč bankam: (a) izvede lahko dokapitalizacijo, (b) odkupi lahko slabe terjatve, (c) garantira lahko del bančnih obveznosti in (d) zagotovi lahko likvidnostno pomoč.[42] Države zagotavljajo podporo finančnemu sektorju že vsaj zadnjih sto let. Ko se je l. 1890 Barings Bank znašla v težavah, je angleška centralna banka skupaj s konzorcijem komercialnih bank zagotovila likvidnostno podporo ter garantirala za del njegovih obveznosti. Podobno je v času velike depresije ravnala ameriška zvezna vlada, ko je banke podprla z nakupi prednostnih delnic. V zadnji krizi je pomoč bankam dosegla zgodovinske razsežnosti. Države Evropske unije so med letoma 2008 in 2014 za njihovo dokapitalizacijo porabile več kot 500 milijard evrov. V Ameriki so v letih 2008 in 2009 v bančni sistem vložili primerljivih 700 milijard dolarjev.[43] Hkrati so centralne banke v ekonomijo vbrizgale stotine milijard likvidnostnih sredstev.

Ukrepi vlad so nedvomno preprečili razpad zahodnega finančnega sistema in pomembno podprli kratkoročno ekonomsko rast. Srednjeročni učinek reševanja bank na ekonomsko rast pa ni jasen. Treba bi ga bilo raziskati, saj je reševanje bank drago in precej pogosto. Raziskave, ki analizirajo učinek paketov pomoči, ki jih zagotovita Mednarodni denarni sklad (MDS) in Svetovna banka (SB) posameznim državam, kažejo, da paketi pomoči nimajo pozitivnega učinka na srednjeročno rast BDP. Dreher (2006) ter Hutchison in Noy (2003) ugotavljajo, da imajo paketi pomoči državam negativen vpliv na rast. Butkiewicz in Yanikkaya (2005) pa zaključita, da je njihov učinek na rast v

[41] Kreditiranje malih podjetij je primer kompleksne finančne pozicije, ker so stroški, povezani s pridobitvijo podatkov o kreditojemalcu, visoki, visoka je tudi možnost asimetrije informacij.

[42] Ta oblika podpore bankam je v zadnjih desetletjih bolj v domeni neodvisnih centralnih bank.

[43] Američani so se na krizo odzvali hitreje in bolj agresivno kot Evropejci, zato so se dokapitalizacije zgodile v zgolj dveh letih.

nekaterih primerih statistično neznačilen.

Med ekonomsko krizo se proračunski primanjkljaj in javni dolg zvišata. K temu pomembno prispevajo stroški reševanja bank. V Evropski uniji in Združenih državah lahko od 10 do 20 % novonastalega dolga, po gospodarski krizi, ki se je začela leta 2008, pripišemo stroškom dokapitalizacije bank. Laeven in Valencia (2010) sta identificirala negativno povezavo med gospodarsko rastjo in javnim dolgom. Za to obstaja precej preprosta razlaga, saj visok javni dolg lahko pomembno omeji diskrecijsko fiskalno politiko v času ekonomske krize, zvišuje pa tudi stroške zadolževanja v času gospodarske konjunkture. Reševanje bank je drago, zato bi pričakovali, da je učinek reševanja bank na srednjeročno gospodarsko rast lahko tudi negativen. Giannetti in Simonov (2012) ugotavljata, da kadar je znesek državne pomoči bankam prenizek, to lahko pripelje do okrepitve kreditiranja bolj tveganih in manj produktivnih podjetij. Sem spadajo tudi t. i. »zombi podjetja«[44]. Banke reprogramirajo njihova posojila, da se izognejo kapitalskim izgubam, ki bi nastale ob stečaju teh podjetij. McGowan, Andrews in Millot (2017) pojasnjujejo, da »zombi podjetja« manj investirajo, prav tako pa je njihova produktivnost nižja. Srednjeročno podpora takim podjetjem negativno vpliva na produktivnost ekonomije, saj zdravim podjetjem onemogoča dostop do svežega kapitala. Nižja produktivnost se odraža v nižji ekonomski rasti. Giannetti in Simonov (2012) ugotavljata tudi, da kadar je znesek državne pomoči zadosten, se trend posojanja obrne. Zdravim podjetjem je na voljo več posojil, dostopnost teh se za »zombi podjetja« zniža. To pomeni, da ima lahko reševanje bank tako pozitiven kot negativen učinek na srednjeročno gospodarsko rast.

Hipoteze in definicije pojmov

V magistrski nalogi smo postavili tri hipoteze (H_1, H_2 in H_3). Osrednja hipoteza (H_1) je, da je povprečna srednjeročna rast BDP nižja v državah, ki so ob bančni krizi reševale banke, kot pri tistih, ki ob bančni krizi bank niso reševale. Z namenom preverjanja specifikacije modela in primerjave rezultatov z obstoječo literaturo bomo testirali še dve hipotezi. Druga hipoteza (H_2) predpostavlja, da je povprečna srednjeročna rast BDP višja v državah, ki so imele bančno krizo, kot v tistih, ki je niso imele. Tretja hipoteza (H_3) predvideva, da imajo bančne krize negativen učinek na povprečno kratkoročno rast BDP.

V tej nalogi analiziramo reševanje bank in pri tem upoštevamo dva tipa ukrepov: državne dokapitalizacije in odkupe slabih terjatev. Zaradi pomanjkanja podrobnih podatkov v znesek državne pomoči ne vključimo likvidnostne podpore in državnih garancij. Podatke o bančnih krizah in stroških njihovega reševanja pridobimo iz raziskave,

[44]»Zombi podjetja« so pogosto definirana kot tiste firme, pri katerih njihov denarni tok skozi daljše časovno obdobje ni zadosten za servisiranje bančnih obveznosti.

ki sta jo opravila Laeven in Valencia (2010, 2018). Dopolnimo jih še z nekaterimi drugimi viri. Za države Evropske unije podatek o skupnem znesku reševanja bank v letih 2008 do 2014 pridobimo iz EU State Aid Scorecard (European Commission, 2017).

V nalogi analiziramo kratko in srednjeročne učinke bančnih kriz in njihovega reševanja na povprečno rast BDP. Rast analiziramo v petletnih obdobjih. Kratkoročni učinki so tisti, ki se zgodijo znotraj istega petletnega obdobja, srednjeročni učinki pa vplivajo na rast v naslednjem petletnem obdobju. Na primer, če naši podatki vsebujejo obdobji 2000–2004 in 2005–2009, bančna kriza pa se zgodi leta 2001, bomo pri analizi kratkoročnih učinkov krize analizirali vpliv te na povprečno rast BDP v obdobju 2000–2004. Pri oceni srednjeročnega učinka krize pa bomo spremljali učinek krize na povprečno rast v obdobju 2005–2009.

Podatki in metodologija

Učinek reševanja bank bomo ocenili z metodo rastnih regresij (angl. growth regression), ki jo je v devetdesetih letih prejšnjega stoletja populariziral Barro (1991, 2003). Ta predpostavi linearno odvisnost med povprečno rastjo BDP in vrednostmi nekaterih makroekonomskih indikatorjev, npr. investicij v BDP, BDP na prebivalca, žensko rodnostjo itd. V zgodnjih študijah so se uporabljali podatki za več različnih držav v istem časovnem obdobju. Vrednost koeficientov se je ocenila s pomočjo OLS cenilke. Kasneje so se začeli uporabljati tudi panelni podatki, tj. podatki so se zbirali za več časovnih obdobij. Vrednost koeficientov se je še vedno ocenila s pomočjo OLS cenilke, toda pod predpostavko, da so vrednosti koeficientov v vseh časovnih obdobjih enake.

Barro v svojih študijah uporabi slepe spremenljivke za ločevanje razvitih in nerazvitih držav ter za oznako različnih časovnih obdobij. Naš model Barrovi specifikaciji doda še tri dodatne slepe spremenljivke: $D^1_{i,t}$, $D^2_{i,t}$ in $D^3_{i,t}$. Te zavzamejo vrednosti 1, kadar je bančna kriza prisotna v danem obdobju ($D^1_{i,t}$), v prejšnjem obdobju ($D^2_{i,t}$) oziroma kadar je bančna kriza prisotna v prejšnjem obdobju, država pa je reševala banke ($D^3_{i,t}$).

V literaturi so izpostavljene tri težave z rastnimi regresijami: (a) endogenost spremenljivk, (b) izbira/robustnost modela ter (c) zamenljivost. V rastnih regresijah je endogenost spremenljivk pogosta. Problematična je, ker povzroča nedoslednost OLS cenilke. Pojavi se zaradi prekrivanja intervalov, uporabljenih za izračun odvisne in neodvisnih spremenljivk. Na primer, Barro (1993) razlaga povprečno rast BDP v obdobju 1960–1985 s pomočjo več makroekonomskih spremenljivk. Ena od teh je povprečna vrednost investicij v BDP v obdobju med letoma 1970 in 1985. Orji in Mba (2010) kot tudi mnogi drugi so potrdili pozitivno povezavo med investicijami in gospodarsko rastjo. Zato prekrivanje intervalov rasti BDP in odvisnih spremenljivk lahko pripelje do simultanosti in obrnjene vzročnosti. Ta se pojavi, kadar spremembe v odvisni spremenljivki povzročajo spremembe v neodvisni spremenljivki; medtem ko simultanost pomeni, da vzročnost med odvisno in neodvisno spremenljivko teče v obeh smereh. Težave z endogenostjo spremenljivk poskušamo odpraviti na način, ki sta ga predlagala Wagner in Hlouskova (2013). Spremenljivke definiramo tako, da se njihovi intervali ne prekrivajo z intervali odvisnih spremenljivk. Na primer, ko razlagamo povprečno rast BDP v obdobju 2000–2004, za vrednost investicij v BDP uporabimo povprečno vrednost iz prejšnjega intervala, torej za leta 1995–1999.

Vrednosti ocenjenih koeficientov v rastnih regresijah so pogosto nestabilne. Spreminja se tudi njihova statistična značilnost. Rezultati regresij so zelo občutljivi na specifikacijo modela. Na primer, vladavina prava je lahko statistično pomembna spremenljivka, kadar se kombinira z BDP na prebivalca in investicijami v BDP, ne pa tudi v povezavi z investicijami v BDP in žensko rodnostjo.[45] Sala-i-Martin, Doppenhoffer in Miller (2004) so težavo z nestabilnostjo koeficientov poskusili rešiti s povprečenjem njihovih ocen. Ta pristop uporabimo tudi mi. Najprej ocenimo vse modele, ki vsebujejo deset izbranih makroekonomskih spremenljivk (glej Tabelo 22 za njihov seznam). Te smo izbrali, ker so se v prejšnjih študijah izkazale za statistično pomembne za rast BDP. Poleg naštetih spremenljivk vsakemu modelu dodamo še tri slepe spremenljivke ($D^1_{i,t}$, $D^2_{i,t}$ in $D^3_{i,t}$), ki smo jih definirali v prejšnjih odstavkih in štiri slepe spremenljivke, ki označujejo posamezna časovna obdobja. Deset spremenljivk lahko kombiniramo na 1024 načinov, kar predstavlja število vseh ocenjenih modelov. Dobljene vrednosti koeficientov obtežimo na tri različne načine: (a) na podlagi Akaikejevega informacijskega kriterija (AIC), Bayesovega informacijskega kriterija (BIC) in z uporabo enake uteži za vse modele (EWE).

Table 22: Seznam izbranih makroekonomskih spremenljivk.

BDP na prebivalca	Razmerje odvisnosti[46]
Odprtost ekonomije[47]	Ženska rodnost
Javni dolg v BDP	Vladavina prava
Doseganje primarne stopnje izobrazbe	Investicije v BDP
Doseganje terciarne stopnje izobrazbe	Bančni depoziti v BDP

Vir: lastno delo.

Rastne regresije se opirajo na predpostavko zamenljivosti. Ta temelji na dveh domnevah in sicer, da so vrednosti koeficientov spremenljivk enake za: (a) vse države in (b) vsa obdobja znotraj našega vzorca. To nam omogoča, da koeficiente spremenljivk ocenimo združeno. Chirwa in Odhiambo (2016) ugotavljata, da predpostavka (a) ne

[45]Primer je izmišljen in uporabljen le za ilustracijo.
[46]Definiran kot delež populacije, stare 65 let in več, v odstotkih populacije, stare med 15 in 64 let.
[47]Definiran kot seštevek uvoza in izvoza v BDP.

drži vedno. Na primer, ocene koeficientov za razvite in razvijajoče se države so lahko precej različne. Z namenom, da se izognemo težavam, ki nastanejo ob kršitvi (a), v naš vzorec vključimo le razvite države.[48] Skupaj zajamemo 41 držav, vse države EU (razen Hrvaške)[49] ter še nekatere države OECD. V osnovnem modelu domnevamo, da predpostavka (b) drži. V okviru robustnostnih testov pa to domnevo preverimo z izvedbo F-testa.

V rastnih regresijah se koeficiente spremenljivk pogosto oceni z metodo najmanjših kvadratov, pri čemer uporabimo OLS cenilko. V večini primerov se izvede združena ocena koeficientov, ki je smiselna ob predpostavki zamenljivosti. Pri združeni oceni se namesto metode najmanjših kvadratov lahko aplicira Zellnerjeva (1962) metoda navidezno povezane regresijske analize, pri kateri uporabimo SUR cenilko. Prednost te je, da dovoljuje, da so napake za posamezno državo med različnimi obdobji lahko povezane. Posledično je SUR cenilka lahko bolj učinkovita kot OLS cenilka.

Poleg ocene osnovnega modela izvedemo še tri robustnostne teste. Prvi test preverja občutljivost ocenjenih koeficientov glede na specifikacijo slepe spremenljivke $D^3_{i,t}$, ki označuje prisotnost reševanja bank v prejšnjem obdobju. Namesto, da $D^3_{i,t}$ zavzame binarno vrednost, njeno vrednost definiramo kot skupen znesek državne pomoči bankam v odstotkih BDP. Namen drugega robustnostnega testa je oceniti vpliv uporabe SUR cenilke, v primerjavi z OLS cenilko, na oceno koeficientov. Tretji robustnostni test pa preverja domnevo, da so vrednosti koeficientov v vseh obdobjih enake. Koeficiente z SUR cenilko ocenimo dvakrat, enkrat z in drugič brez predpostavke, da morajo biti koeficienti v vseh obdobjih enaki. Nato s pomočjo F-testa preverimo, ali drži ničelna domneva, da imajo koeficienti v vseh obdobjih enake vrednosti.[50]

Zaključki in diskusija

Rezultati ocene osnovne specifikacije modela potrjujejo vse tri hipoteze. To velja ne glede na kriterij, ki ga uporabimo za izračun uteži. Naša analiza kaže, da je srednjeročna povprečna rast BDP nižja v državah, ki so imele bančno krizo in so reševale banke, kot v tistih, ki so imele bančno krizo in bank niso reševale (hipoteza H_1). Ocenjujemo, da je povprečna rast lahko nižja za 0,34–0,40 % BDP na leto. Rezultati potrjujejo tudi tezo, da ima bančna kriza kratkoročno negativen učinek na povprečno rast BDP (hipoteza H_3). Ocenjujemo, da rast BDP v povprečju zniža rast za 1–1,10 % na leto. Ta zaključek je pričakovan in skladen z obstoječo literaturo o bančnih krizah. Nenazadnje so bančne krize pomembne prav zaradi njihovega negativnega učinka na BDP. Ugotavljamo tudi,

[48]Podatke pridobimo za leta 1992–2014, povprečno rast BDP pa razlagamo skozi štiri petletne intervale: 1995–1999, 2000–2004, 2005–2009 in 2010–14.

[49]To izključimo zaradi pomanjkanja nekaterih podatkov.

[50]V tej robustnostni študiji uporabimo definicijo spremenljivke $D^3_{i,t}$ iz prve robustnostne študije. V nasprotnem primeru ni mogoče oceniti koeficientov spremenljivk, saj ocena ne konvergira.

da je srednjeročen učinek bančne krize na gospodarsko rast lahko pozitiven (hipoteza H_2). Ocenjujemo, da v povprečju doda 0,62–0,67 % k povprečni letni rasti BDP. Ta rezultat pripisujemo predvsem učinku osnove. Predznake ocenjenih koeficientov spremenljivk tudi primerjamo z literaturo. Ugotavljamo, da so vsi predznaki, razen za delež investicij v BDP, skladni z literaturo. To ne pomeni nujno, da so pravilni, vseeno pa nam vlivajo dodatno zaupanje v pravilno specifikacijo modelov.

Robustnostni testi zgornje ugotovitve potrjujejo. Sprememba definicije spremenljivke $D^3_{i,t}$ ne vpliva na predznake koeficientov, rahlo pa spremeni njihove velikosti. To je najbolj opazno pri koeficientu slepe spremenljivke $D^3_{i,t}$, ki se zaradi njene drugačne definicije precej zniža. V povprečju reševanje bank zmanjša povprečno letno rast BDP le za 0,07 % in ne več za 0,34 % kot kaže osnovni model. Drugi robustnostni test prav tako potrjuje vse tri hipoteze. Ugotavljamo, da uporaba OLS cenilke pripelje do polovico nižje ocene učinka reševanja bank na rast. Predznaki ocenjenih koeficientov pa ostajajo stabilni. Tretji robustnostni test, pri katerem testiramo predpostavko, da so vrednosti koeficientov v vseh obdobjih enake, potrjuje vse hipoteze. S F testom ne moremo zavrniti ničelne hipoteze, da se vrednosti koeficientov makroekonomskih in slepih spremenljivk med obdobji ne razlikujejo. Pravilna interpretacija zavrnitve ničelne hipoteze sicer ne bi bila povsem jasna. Težko bi namreč trdili, da se lahko vpliv nekaterih počasi se spreminjajočih spremenljivk, npr. ženske rodnosti, na rast BDP med obdobji tako močno razlikuje.

Večina avtorjev rastnih regresij opozarja, da treba biti pri interpretaciji rezultatov pazljiv. Sala-i-Marin (1997) ter Levine in Renelt (1991) izpostavljajo identifikacijo statističnih regularnosti v podatkih, kot enega ključnih prispevkov rastnih regresij. Nasprotno pa Barro (2003) na podlagi regresijskih rezultatov formulira predloge ekonomskih politik za posamezne države. Durlaf (2009) ugotavlja, da je tak pristop preveč ambiciozen in meni, da bi se rastne regresije morale uporabljati predvsem za zbiranje stiliziranih dejstev o ekonomski rasti. Pri interpretaciji rezultatov mu sledimo. Glede na precej zapleten raziskovalni problem je potrebna previdnost pri oblikovanju zaključkov. Menimo, da se je smiselno osredotočiti predvsem na predznak ocenjenih koeficientov in njegovo stabilnost. S tem v mislih so oblikovane tudi raziskovalne hipoteze. Vrednosti ocenjenih koeficientov sicer omenimo, vendar menimo, da niso informativne. V najslabšem primeru so lahko celo zavajajoče. Naš model namreč ne kontrolira nekaterih razlik med državami, ki lahko bistveno vplivajo na rezultate. Na primer, model ne razlikuje med manjšimi in zelo hudimi bančnimi krizami. Ena oziroma dve hujši krizi lahko močno vplivata na ocenjeno vrednost koeficienta. Robustna študija tri kaže, da se ta vpliv odraža tudi v predznaku koeficienta, ki ni nujno enak za vsa obdobja. V študijo ne vključimo likvidnostne pomoči ter učinka državnih garancij. Te bi prav tako lahko pomembno vplivale na rezultate. Obstajajo tudi drugi načini reševanja bank (npr. reševanja bank s sredstvi upnikov), ki imajo lahko pomembne učinke, a jih v analizo zaradi pomanjkanja dostopnih podatkov ne vključimo.

Glede na zgoraj napisano ne moremo zaključiti, da je reševanje bank nujno slabo za rast BDP. Vsaj kratkoročno je reševanje bank nujno, saj povrne zaupanje v ekonomijo in prepreči destabilizacijo bančnega sistema. Na primer, če ameriška vlada v letih 2008 in 2009 ne bi podprla Wall Streeta, bi bila kasnejša ekonomska kriza v Ameriki in po svetu verjetno mnogo hujša. Tudi če je učinek reševanja bank srednjeročno negativen kot potrjuje naša analiza, to ne pomeni, da reševanje bank ni potrebno. Naša naloga se je osredotočala predvsem na srednjeročne stroške reševanja, njen cilj ni bil odgovoriti, ali je reševanje smiselno, ko seštejemo kratkoročne koristi in srednjeročne stroške. Ugotovili smo, da srednjeročni stroški reševanja obstajajo, potrebne pa so nadaljnje raziskave, da se bolj točno oceni njihov izvor in raziščejo posledice teh ugotovitev za politiko reševanja bank v praksi.

Appendix 2: Additional data

The following table (and some other tables in the thesis) are made using the R's Stargazer package (Hlavac, 2018). Note: The variables use the following code: V1 - GDP per capita, V2 - Primary education attainment, V3 - Tertiary education attainment, V4 - Total female fertility , V5 - Dependency ratio , V6 - Investment, V7 - Trade, V8 - Rule of law, V9 - Deposits, V10 - Government debt, D1 - $D^1_{i,t}$, D2 - $D^2_{i,t}$, D3 - $D^3_{i,t}$. The data in the table below have already been processed.

Due to formatting reasons Table 23 is presented on the following pages.

Table 23: Dataset summary.

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
AUS	1995	3.05	10.46	4.95	16.87	0.64	2.84	24.34	38.70	1	53.10	30.90	0	0	0
AUS	2000	2.11	10.55	5.43	15.91	0.60	2.88	25.54	40.90	1	61	19.50	0	0	0
AUS	2005	1.55	10.70	5.25	19.47	0.57	2.92	25.48	42.36	1	69.70	10.90	0	0	0
AUS	2010	1.11	10.80	4.04	25.18	0.59	2.95	27.70	41.98	1	93.10	20.50	0	0	0
AUT	1995	2.71	10.46	26.35	5.34	0.41	3.11	25.12	73.70	1	82.70	68.40	0	0	0
AUT	2000	1.54	10.51	22.83	7.58	0.35	3.12	26.30	87.40	1	79.90	66.60	0	0	0
AUT	2005	1	10.64	19.37	10.17	0.31	3.12	24.64	96.44	1	63.60	68.30	1	0	0
AUT	2010	0.74	10.70	16.72	11.53	0.34	3.17	23.86	103.40	1	79	82.40	1	1	2.49
BEL	1995	2.42	10.43	17.31	14.53	0.50	3.14	22.86	121	1	71.30	130	0	0	0
BEL	2000	1.74	10.47	12.68	16.44	0.44	3.18	22.18	136.60	2	82.70	108	0	0	0
BEL	2005	0.60	10.60	10.46	18.07	0.51	3.25	22.10	147.40	1	91	92	1	0	0
BEL	2010	0.49	10.67	9.83	20.27	0.57	3.27	23.86	161	1	95.20	99.70	1	1	7.29
BGR	1995	0.65	8.19	32.25	11.09	0.44	3.04	16.98	92.32	2	51.90	104	1	0	0
BGR	2000	6.53	8.24	26.80	12.74	0.21	3.11	12.47	81.46	3	20.60	70.77	0	1	14
BGR	2005	5.51	8.28	17.47	13.66	0.23	3.20	21.44	110.78	2	36.30	28.50	0	0	0
BGR	2010	1.73	8.62	4.47	16.10	0.31	3.22	31.88	121.40	2	55.70	14.30	0	0	0
CAN	1995	2.56	10.47	5.35	13.05	0.54	2.84	20.66	74.44	1	73.20	100	0	0	0
CAN	2000	1.99	10.54	3.98	15.56	0.49	2.87	20.32	75.40	1	67.80	80.70	0	0	0
CAN	2005	0.19	10.68	2.99	25.42	0.40	2.91	20.44	65.82	1	143	70.90	0	0	0
CAN	2010	1.53	10.76	2.37	27.72	0.43	2.94	23.30	62.18	1	175	81.10	0	0	0
CHE	1995	1.18	11.04	17.83	11.32	0.46	3.07	24.86	85.04	1	104	52.80	1	0	0
CHE	2000	0.96	11.03	17.97	12.49	0.39	3.08	25.10	93.80	1	119	54.60	0	1	0
CHE	2005	1.28	11.12	14.39	14.64	0.41	3.12	23.52	107.60	1	124	58.30	0	0	0
CHE	2010	0.87	11.16	2.13	22.01	0.35	3.15	25	122.40	1	133	46.10	1	0	0
CHL	1995	4.00	8.84	18.05	8.34	0.90	2.31	25	54.86	2	30.10	31.90	0	0	0
CHL	2000	3.40	8.99	13.53	9.48	0.84	2.36	26.22	64.36	2	46.90	13.20	0	0	0
CHL	2005	2.71	9.16	13.33	9.37	0.75	2.43	21.52	73.64	1	44.30	7	0	0	0
CHL	2010	3.67	9.32	9.62	8.22	0.68	2.50	22.26	67.98	1	37.50	8.60	0	0	0

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Table 23: Dataset summary (cont.).

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
CYP	1995	3.20	9.97	24.56	15.81	0.85	2.73	21.82	136.20	1	120	46.80	0	0	0
CYP	2000	3.05	10.05	19.73	19.56	0.75	2.73	22.80	124.20	1	153	56.30	0	0	0
CYP	2005	1.14	10.19	19.30	16.84	0.54	2.72	20.16	109.80	1	167	64.40	0	0	0
CYP	2010	-2.71	10.33	17.29	24.37	0.42	2.74	24.64	112.60	1	207	56.30	1	0	0
CZE	1995	2.29	9.42	12.01	6.91	0.54	2.98	27.08	84.30	2	53.90	14.60	1	1	13.70
CZE	2000	3.64	9.51	0.23	6.49	0.25	2.97	32.22	99.60	2	52.30	18.50	1	1	7.30
CZE	2005	2.89	9.60	0.09	6.75	0.14	2.99	30.26	123.40	1	54.10	29.70	0	1	6.90
CZE	2010	0.94	9.80	0.04	8.61	0.25	2.98	29.76	144.60	1	60.40	38.20	0	0	0
DEU	1995	1.51	10.44	25.01	10.74	0.25	3.10	22.26	48.62	2	57.60	54.80	0	0	0
DEU	2000	0.92	10.46	16.05	12.90	0.22	3.12	23.20	62.32	2	90.90	58.80	0	0	0
DEU	2005	0.77	10.54	2.23	13.52	0.32	3.19	20.98	75.70	1	63.50	66.90	1	0	0
DEU	2010	2.42	10.57	1.25	16.08	0.29	3.34	19.66	83.82	1	72.70	81	1	1	3.51
DNK	1995	2.42	10.73	20.11	13.10	0.57	3.14	19.40	70.44	1	50.90	68.70	0	0	0
DNK	2000	1.31	10.80	10.88	13.44	0.59	3.12	21.30	82.94	1	46.90	52.40	0	0	0
DNK	2005	-0.08	10.93	7.83	16.52	0.57	3.10	21.62	96.32	1	53.20	37.40	1	0	0
DNK	2010	0.76	10.98	5.31	18.97	0.59	3.13	22.98	100.62	1	54.30	42.90	1	1	3.69
ESP	1995	3.15	10.05	21.54	8.01	0.27	3.04	21.50	50	2	62.50	61.80	0	0	0
ESP	2000	2.46	10.07	18.04	12.35	0.15	3.10	23.24	56.12	2	74.10	58	0	0	0
ESP	2005	0.28	10.25	22.73	15.54	0.20	3.19	27.34	53.94	1	76.20	42.30	1	0	0
ESP	2010	-0.90	10.35	20.82	17.01	0.29	3.19	29.36	58.90	1	97.20	60.10	1	1	0.12
EST	1995	3.27	8.83	22.62	13.20	0.54	2.94	25	146.80	2	14.30	8.91	0	0	0
EST	2000	7.76	8.90	9.92	19.29	0.32	3.03	30.74	126.40	2	24.50	5.11	0	0	0
EST	2005	1.87	9.22	5.88	20.10	0.31	3.10	32.36	132.80	1	35.20	4.55	0	0	0
EST	2010	4.11	9.60	4.32	23.67	0.42	3.20	32.64	161.40	1	53.90	6.55	0	0	0
FIN	1995	4.48	10.31	32.54	10.75	0.62	3.03	20.50	66.26	1	52.40	55.20	1	0	0
FIN	2000	2.91	10.37	28.99	13.87	0.59	3.06	21.54	70.72	1	46.20	42.50	0	1	0
FIN	2005	0.47	10.61	25.37	14.96	0.55	3.11	22.88	79.80	1	50.70	39.90	0	0	0
FIN	2010	0.10	10.72	22.04	15.06	0.59	3.18	24.08	77.92	1	62.40	47.10	0	0	0
FRA	1995	2.16	10.41	23.92	7.27	0.55	3.10	21.44	47.04	2	59.80	55.80	0	0	0
FRA	2000	1.38	10.44	20.55	8.80	0.55	3.14	20.34	53.34	2	61.80	58.60	0	0	0

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Table 23: Dataset summary (cont.).

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
FRA	2005	0.09	10.56	20.35	10.02	0.64	3.20	21.82	54.88	1	64.30	67.20	1	0	0
FRA	2010	0.70	10.60	17.78	12.12	0.66	3.23	23.06	58.74	1	76.20	81.70	1	1	1.20
GBR	1995	2.79	10.25	28.73	11.89	0.58	3.20	18.22	49.72	2	61.70	44.40	0	0	0
GBR	2000	2.42	10.33	23.99	15.23	0.54	3.20	18.42	50.52	2	98.80	37	0	0	0
GBR	2005	-0.10	10.48	19.30	15.76	0.49	3.19	17.72	54.16	1	119	40	1	0	0
GBR	2010	1.31	10.59	12.24	18.78	0.57	3.19	16.86	60.14	1	177.45	75.70	1	1	5.40
GRC	1995	2.80	9.89	35.52	12.19	0.31	3.03	18.82	40.72	3	47.40	99	0	0	0
GRC	2000	4.19	9.90	30.80	14.07	0.25	3.08	23.52	52.58	3	47.20	105	0	0	0
GRC	2005	0.70	10.06	33.74	21.45	0.22	3.18	25.78	53.66	2	78.40	107	1	0	0
GRC	2010	-4.51	10.23	30.23	24.85	0.29	3.28	23.64	60.60	2	100	146	1	1	1.59
HUN	1995	2.67	9.06	23.64	10.36	0.57	3.04	20.44	95.46	2	36.20	84.50	0	0	0
HUN	2000	4.56	9.10	11.14	11.70	0.45	3.05	26.10	125	2	36.10	55.10	0	0	0
HUN	2005	0.75	9.26	5.12	13.93	0.28	3.10	26.44	146.80	1	40	60.50	1	0	0
HUN	2010	1.73	9.48	1.60	17.65	0.27	3.12	24.06	164.80	1	50.40	80.60	0	1	0.23
IRL	1995	8.39	10.12	22.63	12.87	0.69	2.87	22.34	147	1	53.60	82.10	0	0	0
IRL	2000	4.59	10.28	17.51	17.09	0.61	2.82	22.08	161.60	1	71.60	37.80	0	0	0
IRL	2005	-0.56	10.67	14.86	21.68	0.64	2.75	25.16	156.80	1	72.80	27.40	1	0	0
IRL	2010	2.63	10.85	14.11	30.27	0.62	2.73	27.24	191.40	1	107	86.30	1	1	6.47
ISL	1995	5.12	10.10	37.76	9.18	0.79	2.83	18.38	70.48	1	36.40	58.90	0	0	0
ISL	2000	2.84	10.29	34.16	11.33	0.73	2.86	21.14	71.46	1	39.40	41	0	0	0
ISL	2005	1.39	10.51	30.35	14.16	0.73	2.88	22.54	80.58	1	58.20	24.60	1	0	0
ISL	2010	1.13	10.66	27.17	18.32	0.72	2.88	27.14	99.28	1	91.40	88.30	0	1	34.94
ISR	1995	2.06	10.01	21.79	20.85	0.99	2.72	23.70	62.42	3	54.20	102	0	0	0
ISR	2000	0.58	10.11	19.99	23.83	1.06	2.77	24.68	70.64	3	71.20	84.40	0	0	0
ISR	2005	1.95	10.23	17.44	27.01	1.08	2.79	21.08	77.38	2	79.60	88.20	0	0	0
ISR	2010	2.16	10.23	9.48	28.62	1.04	2.78	20.10	67.96	2	82.20	70.70	0	0	0
ITA	1995	1.81	10.36	30.69	5.05	0.26	3.12	18.78	44.68	2	51.70	109	0	0	0
ITA	2000	1.22	10.40	25.63	6.13	0.17	3.19	19.54	48.54	2	49	105	0	0	0
ITA	2005	-0.90	10.50	22.04	6.63	0.23	3.29	21.02	51.64	1	56.40	102	1	0	0
ITA	2010	-0.99	10.52	18.22	8.04	0.29	3.38	21.28	55.08	2	73.60	115	1	1	0.26

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Table 23: Dataset summary (cont.).

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
JPN	1995	0.84	10.58	20.27	15.18	0.41	2.91	28.06	18.54	2	190	95.10	1	1	3
JPN	2000	1.23	10.61	16.39	17.19	0.35	3.03	29.28	21.16	2	220	144	0	1	8.60
JPN	2005	-0.40	10.65	13.48	19.18	0.31	3.21	25.46	29.76	2	184	186	0	0	0
JPN	2010	1.71	10.70	9.71	19.94	0.23	3.38	23.94	32.24	2	200	216	0	0	0
KOR	1995	4.86	9.18	17.30	15.59	0.57	2.06	34.54	59.26	2	30.40	7.11	1	0	0
KOR	2000	5.09	9.40	14	20.77	0.49	2.13	34.96	65.64	2	55.50	17.10	0	1	31.20
KOR	2005	3.10	9.62	11.81	25.95	0.39	2.30	31.90	82.46	2	58.80	27	0	0	0
KOR	2010	3.15	9.83	10.54	34.79	0.08	2.51	31.80	102.80	2	62.80	30.80	0	0	0
LTU	1995	5.31	8.99	12.01	9.28	0.68	2.85	19.15	88.52	2	12.60	8.78	1	0	0
LTU	2000	7.75	8.58	9.23	11.06	0.44	2.92	22.80	95.40	2	15.30	23.50	0	1	3.10
LTU	2005	4.16	8.84	9.15	17.45	0.33	3.05	20.58	116.60	1	28	18.30	0	0	0
LTU	2010	5.29	9.26	6.93	19.93	0.25	3.17	24.64	155	1	40.50	36.30	0	0	0
LUX	1995	3.24	11.17	27.51	8.99	0.49	2.99	21.58	211.60	1	288	7.40	0	0	0
LUX	2000	2.68	11.22	23.78	10.58	0.53	3.03	21.60	267.40	1	290	6.46	0	0	0
LUX	2005	0.53	11.45	19.76	14.42	0.57	3.04	20.92	318.40	1	372	7.48	1	0	0
LUX	2010	0.74	11.52	15.20	21.21	0.49	3.07	19.08	344.60	1	350	20.10	0	1	6.83
LVA	1995	4.19	9.10	16.42	9.68	0.55	2.95	21.45	84.52	2	15.30	11.80	1	0	0
LVA	2000	8.33	8.54	12.32	9.87	0.22	3.04	20.96	86.02	2	16.20	15	0	1	3
LVA	2005	4.03	8.84	4.22	10.75	0.22	3.10	28.86	95.34	1	29.10	11.80	1	0	0
LVA	2010	3.62	9.30	3.43	12.23	0.33	3.20	34.58	120.80	2	44.50	40.30	1	1	2.18
MEX	1995	1.37	8.98	20.38	7.55	1.18	2.03	23.64	49.42	4	25.20	56.80	1	0	0
MEX	2000	0.66	8.93	19.34	9.14	1.11	2.06	22.30	50.98	3	24.60	41.80	0	1	14.40
MEX	2005	-0.54	9.11	18.96	11.24	1.00	2.12	21.42	57.82	2	20.20	39	0	0	0
MEX	2010	1.82	9.11	18.43	13.08	0.92	2.16	23	63.78	3	24.70	42.20	0	0	0
MLT	1995	4.34	9.46	23.95	6.25	0.73	2.80	26	233.60	1	98.70	45.10	0	0	0
MLT	2000	1.96	9.60	22.64	7.26	0.57	2.84	25.38	221.40	1	123	64.20	0	0	0
MLT	2005	1.54	9.81	26.19	9.21	0.52	2.89	19.80	262.80	1	134	70.10	0	0	0
MLT	2010	2.97	9.88	25.11	11.86	0.32	2.98	21.22	309	1	125	67.60	0	0	0
NLD	1995	3.54	10.50	14.03	12.90	0.46	2.93	21.90	112	1	72.10	76.10	0	0	0
NLD	2000	1.16	10.56	12.16	14.58	0.43	2.95	22.94	118.80	1	87.60	53.80	0	0	0

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Table 23: Dataset summary (cont.).

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
NLD	2005	1.16	10.74	8.92	16.56	0.54	3.00	21.70	128.20	1	86.80	48.90	1	0	0
NLD	2010	0.49	10.78	8.78	19.12	0.54	3.04	21.60	144.60	1	97	59.30	1	1	2.97
NOR	1995	3.23	11.06	27.43	9.99	0.63	3.23	24.54	70.90	1	49.30	38.50	0	0	0
NOR	2000	1.74	11.16	21.86	12.23	0.63	3.21	24.86	70.22	1	43.20	28.10	0	0	0
NOR	2005	0.35	11.31	0.18	13.98	0.62	3.16	20.80	71.66	1	47.80	42	0	0	0
NOR	2010	0.23	11.39	0.28	15.26	0.61	3.12	24.98	68.40	1	54.70	42.40	0	0	0
NZL	1995	2.26	10.06	26.94	18.74	0.75	2.85	22.08	57.30	1	69.60	50.60	0	0	0
NZL	2000	2.48	10.18	26.55	19.17	0.69	2.87	22.74	63.02	1	77.10	26.70	0	0	0
NZL	2005	0.96	10.28	25.39	19.92	0.68	2.89	23.42	59.10	1	73.90	18.50	0	0	0
NZL	2010	1.39	10.40	27.20	18.33	0.68	2.90	23.26	57.08	1	87.40	26.90	0	0	0
POL	1995	5.68	8.64	30.08	6.14	0.67	2.77	20.05	50.08	2	23.20	49	0	0	0
POL	2000	3.57	8.79	21.78	8.34	0.48	2.81	23.16	64.08	2	34	36.60	0	0	0
POL	2005	4.77	9.05	20.12	10.06	0.31	2.87	20.40	76.96	1	36.20	46.70	0	0	0
POL	2010	3.06	9.21	16.89	13.98	0.22	2.92	22.42	88.58	1	46.50	53.30	0	0	0
PRT	1995	3.71	9.78	47.16	3.68	0.43	3.06	20.28	61.90	1	80.20	59.10	0	0	0
PRT	2000	0.95	9.80	45.73	4.42	0.34	3.11	26.48	63.58	1	85.70	48.40	0	0	0
PRT	2005	0.24	9.98	43.28	3.50	0.44	3.18	26.14	66.70	1	78.10	62.50	0	0	0
PRT	2010	-0.52	10.00	41.03	3.67	0.34	3.24	22.88	74.82	1	83.10	96.20	1	0	0
ROU	1995	0.97	8.37	1.73	4.96	0.41	2.82	26.70	58.50	3	14.40	18.60	1	0	0
ROU	2000	6.40	8.50	1.56	6.24	0.29	2.88	20.58	75.38	2	17.30	23.70	0	1	6.50
ROU	2005	5.39	8.50	1.44	6.36	0.27	3.00	22.38	69.50	2	21.70	17.60	0	0	0
ROU	2010	2.10	8.83	1.24	8.05	0.34	3.10	28.40	78.86	2	32.30	30.50	0	0	0
SGP	1995	2.31	10.08	17.21	7.20	0.54	2.09	31.94	331.80	5	71.10	69.40	0	0	0
SGP	2000	4.18	10.28	6.81	14.51	0.51	2.18	34.26	372.40	5	97.80	81.30	0	0	0
SGP	2005	1.62	10.42	20.01	14.79	0.47	2.33	25.80	411	4	93.70	94.30	0	0	0
SGP	2010	4.98	10.60	4.08	30.55	0.23	2.42	25.04	369.80	4	114	99.60	0	0	0
SVK	1995	4.30	8.95	19.71	6.27	0.66	2.79	24.90	109.88	3	49.60	19.10	1	0	0
SVK	2000	4.04	9.07	18.88	6.39	0.42	2.78	32.54	124.60	2	53.60	24	1	1	0
SVK	2005	5.20	9.24	5.98	7.40	0.26	2.80	28.58	156.60	1	48	33.90	0	1	0
SVK	2010	2.63	9.49	0.58	9.13	0.24	2.79	27.36	173.40	1	46.60	40.80	0	0	0

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Table 23: Dataset summary (cont.).

Country	Period	GDP growth	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	D1	D2	D3
SVN	1995	5.16	9.55	11.91	8.20	0.29	2.80	19.05	94.56	2	27.40	16.80	0	0	0
SVN	2000	3.48	9.62	5.90	10.40	0.25	2.87	26.30	105	2	40.30	29	0	0	0
SVN	2005	2	9.83	4.43	11.74	0.23	3.00	27.04	126.40	1	45.60	26.30	0	0	0
SVN	2010	-0.004	10.00	3	15.02	0.23	3.09	29.52	139	1	51.40	38.20	1	0	0
SWE	1995	3.26	10.50	18.45	14.02	0.74	3.33	22.18	72.40	1	42	81.10	0	0	0
SWE	2000	2.70	10.54	14.04	15.11	0.55	3.31	20.84	79.38	1	42	64.30	0	0	0
SWE	2005	0.37	10.71	8.20	17.79	0.43	3.29	22.10	87.88	1	41	48	1	0	0
SWE	2010	1.61	10.82	9.75	18.64	0.57	3.28	23	86.34	1	55.10	37.60	0	1	0.24
TUR	1995	2.72	8.84	40.60	6.45	1.08	2.07	25.58	45.26	5	21.60	34.60	0	1	1.10
TUR	2000	2.96	8.90	45.83	6.27	1.02	2.13	24.08	46.52	5	28.30	51.30	1	0	0
TUR	2005	2.17	9.02	47.61	5.62	0.92	2.26	22.16	47.34	3	32.70	52.70	0	1	32
TUR	2010	5.97	9.18	46.22	7.09	0.82	2.33	27.44	50.52	3	48.60	42.30	0	0	0
USA	1995	2.81	10.51	2.26	24.71	0.72	2.97	20.56	22.86	1	54.40	68.80	0	1	2
USA	2000	1.71	10.56	2.10	26.73	0.68	2.97	22.26	23.34	1	60.80	53	0	0	0
USA	2005	0.01	10.72	2.04	27.85	0.72	2.93	22.30	27.02	1	64.20	64.90	1	0	0
USA	2010	1.41	10.80	1.71	30.94	0.72	2.91	21.44	29.90	1	80.60	94.70	0	1	4.50

Source: own work and data sources from Table 5.