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Expansionary Fiscal Austerity

New International Evidence

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Abstract

The expansionary fiscal contraction (EFC) hypothesis states that fiscal austerity can increase output or consumption when a country is under heavy debt burdens because it sends positive signal about the country's solvency situation and long-term economic wellbeing. Empirical tests of this hypothesis have suffered from identification concerns due to data sources and empirical methodology. Using a sample of OECD countries between 1978 and 2014, this paper combines new IMF narrative data and the proxy structural Vector Auto-regression (SVAR) method to examine whether fiscal austerities can be expansionary when debt levels are high. Fiscal austerities are measured as 1) narrative fiscal shocks and 2) structural shocks from a proxy SVAR. Additionally, this paper uses a model-based approach to determine the cutoff debt level beyond which EFC is expected to be observed. This paper finds empirical evidence in support of the EFC hypothesis for OECD countries: results for output are driven by changes in tax rates and are robust to how one defines a high-debt regime and how one measures austerity.

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Expansionary Fiscal Austerity: New International Evidence*

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1 Introduction

A country engages in fiscal consolidation programs, increasing taxes or cut government expenditures, when the national debt level is deemed high enough to influence the ability of the country to borrow in the future or to prevent the government of the country to undertake necessary public spending programs. If the need for fiscal consolidation arises when the economy is at relative stagnation or decline, policy-makers usually worry that fiscal consolidation efforts present an unnecessary drag on aggregate demand. It is therefore important to understand the output or consumption costs of fiscal austerity to weigh it against the benefit of reducing the national debt stock. The expansionary fiscal contraction (EFC) hypothesis states that fiscal austerity can increase, or at least not decrease output or consumption when a country is under heavy debt burdens because it sends positive signal about the country's solvency situation and long-term economic wellbeing. If this hypothesis is true, policy implications for fiscal austerity programs are clear: the cost of austerity relative to its benefit will be low if debt burden is high enough, and more austerity programs should be undertaken in this case. The question remains whether there is sufficient support for the EFC hypothesis in the data.

This paper seek to bring new empirical evidence to bear on the subject of expansionary austerity by producing a new model-based definition of a high-debt regime, leveraging a newly constructed cross-country narrative dataset and using a new econometric methodology. An empirical answer on this subject will depend crucially on how one defines when the debt level is high enough for austerities to have anti-Keynesian effects and on how one defines austerities themselves. In this paper, I introduce a new definition of a high-debt regime by calibrating a model of expansionary austerity for each country in my sample, and I use this definition along with the conventional cutoff debt levels. I consider two alternative definitions of austerity: fiscal consolidations constructed by the reading of narratives, a direct measure, and structural shocks from identified VARs, an indirect measure. For the former, I use a new source of cross-country narrative dataset constructed by the Fiscal Affairs department of the International Monetary Fund. For the later, I employ a relatively new econometric approach, the proxy structural VAR approach, which combines the attributes two leading empirical methodology in this literature.

Related Literature A large literature focuses attention on the macroeconomic effect of fiscal measures. One branch of this literature identifies the motivation of fiscal reforms from careful examination of narrative records, such as legislative documents, news articles and presidential speeches, and using exogenous fiscal changes thus obtained for the estimation of fiscal multipliers of output and consumption. Ramey and Shapiro (1998), Romer and Romer (2010) are leading examples studying fiscal changes in the United States. Researchers have also applied the narrative approach to the study of other countries: Devries et al. (2010) for fiscal consolidations in a sample of OECD countries, Cloyne (2013) for the UK and Hayo and Uhl (2014) for Germany. Most recently, Alesina et al. (2016) extends the Devries studies by focusing on a detailed composition of a multi-year fiscal plan. Alesina et al. (2017) extended the Devries sample to 2009-2013, a period where plenty of consolidation was taking place. With the increasing availability of micro-level data, cross-sectional studies of fiscal policy, such as Nakamura and Steinsson (2014), provides evidence on the size of the cross-sectional fiscal multiplier.

Another branch of the empirical study of fiscal policy, most notably Blanchard and Perotti (2002), focuses on the identification of structural shocks in Vector Autoregression(VAR). The estimates of the size of the fiscal multiplier differ substantially from narrative estimates. A number of works attempt to reconcile the difference from various perspectives: Ramey (2010) pointed out that VAR shocks are missing the timing of the news announcements; Mertens and Ravn (2013, 2014) developed the proxy structural VAR(PVAR) approach: a structural VAR with narrative shocks as instruments in identification.

The subfield of the literature on deficit-driven fiscal consolidations is rich with policy implications. Frequently-asked questions include: What is the output effects of fiscal consolidation? When is fiscal austerity programs more likely to succeed? Is there such a thing as "expansionary austerity"? Theoretically, Perotti (1999) and Sutherland (1997) provided theoretical channels through which fiscal austerity programs could be associated with increased consumption when debt burden is high. Alesina and Perotti (1996) provides early empirical evidence in this direction, and recent advances include Blanchard and Leigh (2013), Guajardo, Leigh and Pescatori (2014) and House, Proebsting and Tesar (2015). In general, empirical studies using a sample prior to 2009 show mixed or supportive evidence of “expansionary austerity”, while data since 2009 points to the contrary.

This paper is organized as follows. Section 2 reviews a theoretical model of expansionary austerity and calibrate the model to deliver a definition of high-debt regime for each country in my sample. Section 3 introduces a new source of narrative data, checks the quality of the data in a VAR exercise and presents empirical results using the narrative series as a direct measure of austerity. Section 4 uses structural shocks recovered from a proxy structural VAR as an indirect measure of austerity and presents another set of empirical results under this alternative definition. Section 5 concludes.

2 Model-based definition of high-debt regime

An empirical study of expansionary austerity has to start by defining when debts are ”too high”. The literature has so far used empirical debt thresholds advocated by policy institutions. In this section, I provide a way of defining high-debt regimes based on Sutherland(1997)’s theoretical model of expansionary austerity. I calibrate the model to provide a cutoff debt-to-GDP value for each country. The model is presented below and a cutoff value for each country derived.

The model is in continuous time and the environment features a finitely-lived representative consumer and a government. Let B_t be the stock of per capita public debt, F deficit spending and r the interest rate paid on public debt. The evolution of government debt is governed by a Brownian motion, where W_t is a standard Wiener process and σ scales up the variance:

$$dB_t = rB_t dt + F_t \tag{1}$$

$$F_t = \sigma dW_t \tag{2}$$

This process means the government routinely overspends, and hence it institutes periodic fiscal austerity program to satisfy the intertemporal budget constraint. Stabilization programs take the following form: when the stock of debt, B_t is larger than some crisis level, U, the government impose a one time lump-sum tax of the size T to bring down the debt level to U-T. Symmetrically, when $B_t < L$, a one time lump-sum transfer of the size T bring up the debt level to L+T.

Consumers are finitely lived and discount future utility with a Poisson death rate, θ, in addition to the interest rate. Hence, they maximize

$$E_0 \int_0^\infty u(C(t)) \exp(-(r+\theta)t) dt \tag{3}$$

subject to the following flow budget constraint, where government deficit spending is assumed to be a transfer to the household which increases its stock of wealth:

$$dA_t = [y - C_t + (r+\theta)A_t]dt + F_t - \delta(t)T \tag{4}$$

Here, y is fixed per-period income and A_t household wealth in the form of bond holdings. $\delta(t)$ is an indicator that takes on the value of 1 when there is a stabilization tax, 0 during "normal times" and -1 when there is a stabilization transfer. Like usual deficit spending, austerity programs change the wealth of households. Define S, the expected discounted future tax liabilities from possible austerity programs, as follows:

$$S_t = E_t \int_t^\infty \delta(\tau) T \exp(-(r+\theta)(\tau - t)) d\tau \tag{5}$$

Clearly, S_t is a function of current stock of debt, B_t, since the possibility of future stabilization depends on how close B_t is to the critical values. Rewrite S as the sum of expected future tax liabilities from t to Δt and from Δt to ∞, and let Δ_t approaches dt, assuming stabilization do not take place during this small time period, and differentiate S, I obtain:

$$E_t dS = (r+\theta) S dt \tag{6}$$

Applying Ito's lemma to the function $S(B_t)$, another equation is obtained:

$$E_t dS = [rBS'(B) + \frac{\sigma^2}{2} S''(B)]dt \tag{7}$$

Combining equation 6 and 7, we have a second order differential equation in $S(B_t)$. Solution is obtained with two initial conditions given by government behaviors at the two critical values, U and L:

$$S(U - T) = S(U) - T \tag{8}$$

$$S(L + T) = S(L) + T \tag{9}$$

Having characterized the solution for S, I return to the consumer's problem. With quadratic utility, intertemporal consumption smoothing implies a consumption rule of the following:

$$C_t = y + (r + \theta)[A_t - S(B_t)] \tag{10}$$

Changes in consumption depends on changes in asset position and expected future tax liability from possible stabilization programs. An increase in deficit spending, whether a spending hike or a tax break, increases household asset one for one as it is assumed to be a direct transfer. However, deficit spending increases total stock of debt and hence S, the expected future taxes from austerity. In other words, the conventional Keynesian effect of fiscal stimulus increases consumption through changing consumer's permanent income, but the worry of impending stabilization taxes works to the opposite direction. The precise magnitude of the unconventional effect depends on how close the current debt level is to the critical levels and on the first derivative of the function S.

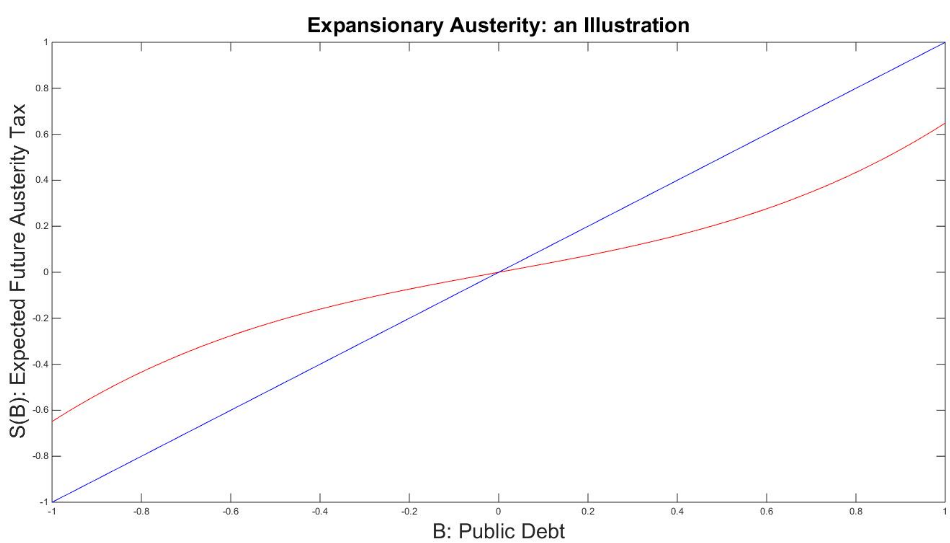
It should be clear that this model, with proper calibration, is capable of delivering a cutoff level of national debt level beyond which one may observe expansionary austerity. This cutoff level, B^*, is defined as:

$$S'(B^*) = 1 \tag{11}$$

At B^*, the conventional and unconventional effect would exactly cancel out. When $B^* < B$, the conventional effect dominates and hence it is impossible to identify the anti-Keynesian effect. When $B^* > B$, the model predicts that austerity should increase consumption.

In figure 1, I graph the function S against the 45-degree line with a set of parameter values for illustrative purpose. B^* depends on T, the expected size of stabilization tax, σ, the variance of the government debt accumulation process, r, the real interest rate, θ, the Poisson death rate of households, and U and L, the exogenous debt limits. Intuitively, U and L determines how far the economy is from triggering austerity programs; given how far the economy is from U and L, σ and r then determines how fast it gets there, if at all; T is the expected loss/gain of wealth once the economy gets to U and L. Ricardian equivalence is broken here only because households are finitely lived, so θ matters because consumers care less about a tax that is coming after their death than a tax imminent during their lifetime.

Figure 1: S(B) under the following parametrization: $\theta = 0.1$, r = 0.05, $\sigma = 0.2$, U = 1, L = -1, T = 0.3



In this graph, B^* is the point at which the derivative of S is parallel to the 45-degree line. For this set of parameter value, $B^* = 0.853$. Calibrating the six parameters to each country's data will produce a unique cutoff value B_i^* for each country i.
For all 17 OECD countries used in my sample in the empirical sections, I calibrate

the six parameters at annual frequency using data between 1981 - 2009. I set every parameter as a percentage of GDP, whenever applicable. The OECD advocates a prudential debt target of 70-90% for advanced economies, but only 50-70% for Eurozone countries since they do not control monetary policy. Hence, I set U = 0.6 for Eurozone countries and U = 0.8 otherwise. r is the sample average of annualized return on 10-year government bond. θ is the inverse of the sample average of life expectancy at birth. σ is the variance of government primary balance from IMF's Historical Public Finance dataset.

T is calibrated with the narrative fiscal series in Devries et al. (2010). The dataset provided sizes of both tax and spending based austerity programs relative to GDP on an annual basis. I calculate T as the average of the size of austerity programs in the sample, not the average of annual size, since most such programs span through multiple years. In the model, T is the size of a one-time tax that constitutes the entire stabilization program, so its empirical counterpart should be an entire program. For instance, if a country reduced its budget deficit by 3% of GDP in each year between 1983 and 1986 as prescribed in a legislation passed in 1982 and by 4% of GDP in 1996 as prescribed in a legislation passed in 1995, then there are two austerity programs in the sample with respective sizes of 9% and 4%. Accordingly, T is set to 0.065, the average size of these programs. All parameter values used for each country are shown in Table 7 Appendix III.

Table 1 below displays the value of B^* for each country in the sample. A definition of a high-debt regime for country i at time t, D_{it}, is available: $D_{it} = 1$ if $B_{i,t} > B^*$, $D_{it} = 0$ otherwise.

3 Testing the EFC hypothesis with new narrative data

In this section, I test the EFC hypothesis empirically by using a new source of cross-country quarterly narrative data of tax-based consolidations as a direct measure of fiscal austerity. The narrative data is briefly introduced and a quality check of the

Table 1: Critical debt level B^*, % of GDP

Country	AUS	AUT	BEL	CAN	DNK	FIN	FRA	DEU	
B^*	78.9	58.9	56.1	75.9	76.7	54.1	59.5	58.1	
Country	IRE	ITA	JPN	NLD	PRT	ESP	SWE	GBR	USA
B^*	56.4	54	79.1	57.1	58.3	57.4	77.2	78.8	79.2

The calculation of these thresholds are based on prudential debt targets advocated by the OECD and meant as part of a simulation exercise. The numbers should not be interpreted as policy suggestions.

data with panel PVAR is performed before the main empirical analysis. Main empirical results are presented with two alternative definitions of high-debt regime, a model-based definition from the last section and a conventional one.

3.1 Overview of the narrative data

Cross-country empirical studies of the effects of fiscal policy have suffered from a lack of data: quarterly narrative series exist for a number of advanced economies, such as Romer and Romer(2010) for the United States and Cloyne (2013) for the United Kingdom. Devries et al. (2010) constructed cross-country narrative series at annual frequency, but such data were not available at quarterly frequency until recently. In this section, I use a newly-constructed IMF quarterly panel dataset of narrative tax series to study expansionary austerity.

The narrative dataset is compiled by the fiscal affairs department at the IMF and it is described in Dabla-Norris and Lima(2018). The dataset contains detailed information on the expected revenue impact, motivation, announcement and implementation dates of nearly 2,500 tax measures of fiscal consolidation across 10 OECD countries between 1978 and 2014. The authors rely on contemporaneous primary sources including budget documents, reports from the Ministry of Finance and tax authorities, technical reports and notes produced during the legislative procedure, and discussions on tax reforms during parliamentary debates. When necessary, these are complemented by information from secondary sources such as IMF staff reports, OECD Economic Surveys, Stability and Growth Pact documents, and news articles on tax reform from national newspapers or from the International Bureau of Fiscal Documentation (IBFD).

3.2 Quality check of the narrative data

Before proceeding to the main empirical results, a quality check of the narrative data is conducted by extending results in Mertens and Ravn(2013) to a cross-country setting. Critics of the narrative approach in the literature are often skeptical of the quality of these narrative data because the construction of such data relies on the reading of a large amount of narrative sources by a few authors to determine motivations and intentions behind a large number of policy changes. Therefore, the produced dataset are subject to errors and depend heavily upon subjective judgment calls made by the authors. Hence, a quality check is necessary before using the series to study the main research question of this paper.

The quality check takes the form of examining the responses of macroeconomic and fiscal variables to change in personal income tax(PIT) rate and corporate income tax(CIT) rate for a panel of OECD countries. Mertens and Ravn(2013) documents such responses for the United States in a PVAR setting after constructing narrative series for PIT and CIT changes, respectively. The narrative dataset in Dabla-Norris and Lima(2018) provides granular information on tax-based fiscal consolidations, most importantly on tax rate or tax base changes for a panel of OECD countries. It can be seen as an extension of Mertens and Ravn(2013)'s work on narrative data to more countries. Hence, a natural quality check is to extend the results for the responses to PIT and CIT shocks to these OECD countries.

Since we do not have a long enough time-series to carry out PVAR for each country, we aim to extend the PVAR methodology to a panel setting, pooling our estimates of structural parameters(elasticities) while estimating reduced-form VARs for each country. The procedure is divided into four steps and described below:

The first step estimates country-specific reduced-form VARs: Consider the following model for $X_{i,t}$ for each country i,

$$X_{i,t} = A_{0,i} + \Sigma_{p=0}^{P} A_{p,i} X_{i,t-p} + u_{i,t} \tag{12}$$

Equation 12 is estimated for each country so as to obtain country-specific reduced form VAR coefficients $A_{0,i}$ and $A_{p,i}$. Lag orders p is determined by standard lag-order selection criterion. We obtain country-specific reduced-form shocks, $u_{i,t}$, in this step.

The second step pools estimates of structural parameters of the system: let $u_t = [u_{1,t}, u_{2,t}, ...]'$ be a vector of stacked country-specific reduced-form shocks and $m_t = [m_{1,t}, m_{2,t}, ...]'$ be a vector of stacked narrative shocks. $\epsilon_{i,t}$ are structural shocks. The following proxy structural VAR model is then estimated:

$$u_t = B\epsilon_t \tag{13}$$

Here, the structural errors satisfies $E[\epsilon_t] = 0$ and $E[\epsilon_t \epsilon_t'] = I$. Since $E[u_t u_t'] = BE[\epsilon_t \epsilon_t']B' = BB'$, and the sample analogue of $E[u_t u_t']$ is a n-by-n covariance matrix, it provides $\frac{n(n+1)}{2}$ independent identification restrictions. There are n parameters in the original system, so the system is under-identified.

Mertens and Ravn's PVAR identification approach avoids directly imposing values of certain structural parameters. Instead, the PVAR approach uses narrative shocks to obtain additional covariance restrictions. Consider the following partitioning of B and ϵ_t: $B = [\beta_1 \beta_2], \beta_1 = [\beta_{11}' \beta_{21}']', \beta_2 = [\beta_{12}' \beta_{22}']'$, $\epsilon_t = [\epsilon_{1t} \epsilon_{2t}]$ and $\Sigma_{mu'} = [\Sigma_{mu'1} \Sigma_{mu'2}]$. Let m_t be an k-dimensional vector of narrative tax shocks, we have the following assumptions:

$$E[m_t \epsilon_{1t}] = \Phi \tag{14}$$

$$E[m_t \epsilon_{2t}] = 0 \tag{15}$$

Namely, the narrative tax shocks are positively correlated with the structural tax disturbances they seek to capture, but are uncorrelated with other structural disturbances. Combining 3 and 4 with 2, the identification assumptions implies the following restrictions on elements of B:

$$\Phi\beta' = \Sigma_{mu'} \tag{16}$$

$$\beta_{21} = (\Sigma_{mu'1}^{-1}\Sigma_{mu'2})'\beta_{11} \tag{17}$$

These additional restrictions allows the structural VAR to be just-identified. I obtain common structural parameters(elasticities) B_i in this step.

The third step obtains country-specific impulse response functions using the vector of country-specific reduced form parameters $\Omega_i^d = [A_{0,i}, A_{1,i}, ..., A_{p,i}]$ and common structural parameters in the matrix B.

The last step obtains averaging IRFs and their bootstrap confidence intervals: the average impulse response functions is calculated as a simple arithmetic average of the country-specific impulse response functions. The confidence intervals of the average IRFs is computed by an amended wild bootstrap procedure designed specifically for our setting. The algorithm used is detailed in the computational appendix.

Figure 2 shows responses of selected variables to a 1 percentage point cut in average personal income tax rate(APITR). 95% bootstrap confidence intervals are shown along with the point estimates of the impulse responses. I find that APITR remains below the expected level prior to the shock during the first year. Afterwards, the APITR converges to its pre-shock level in the long-run. The tax-rate cut sets off an increase in personal income tax base in the short-run, but the increase moderates in the longer run. The tax-rate cut provides a short-run stimulus to output: a 1 percentage point decrease in APITR leads to a peak increase of output of around 1 percent which occurs three quarters after the cut. The confidence intervals indicate a significant increase in economic activity within a 6-quarter window after the tax cut. Government spending also increases following the cut in APITR. These results are broadly in line with results in Mertens and Ravn(2013), but differ slightly in magnitude and timing of the responses, since their study focuses on the United States and this paper extends the analysis to a panel of OECD countries.

Figure 2: Impulse responses to a 1 percentage point cut in average personal income tax rate

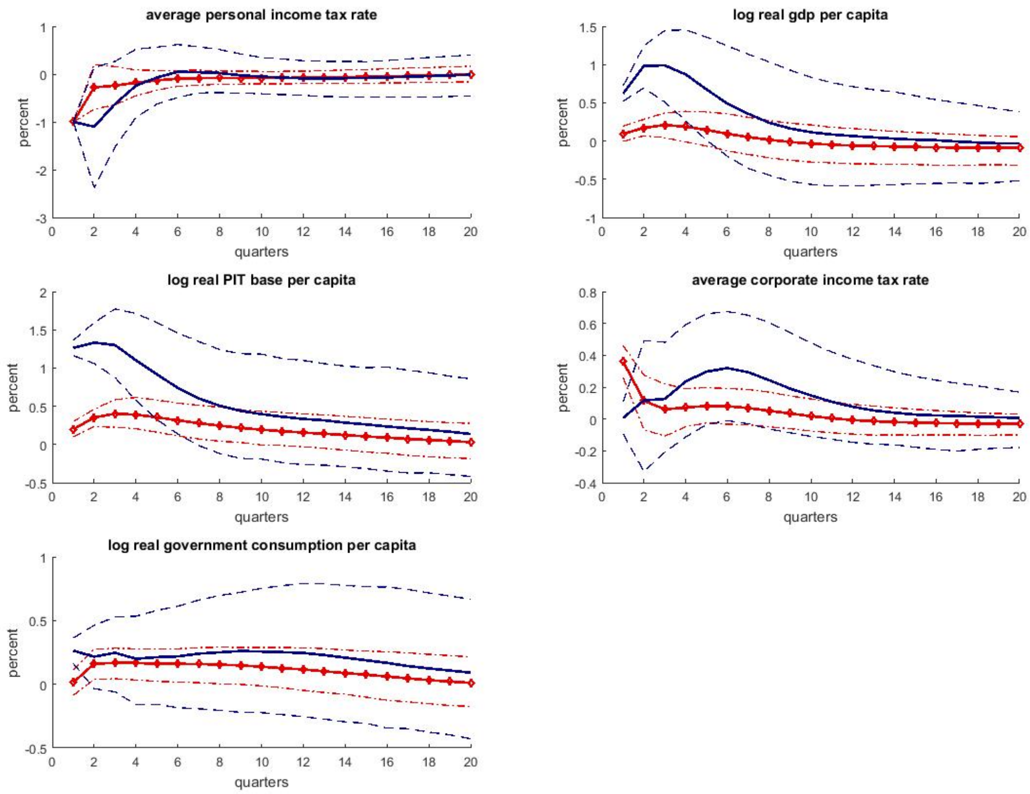
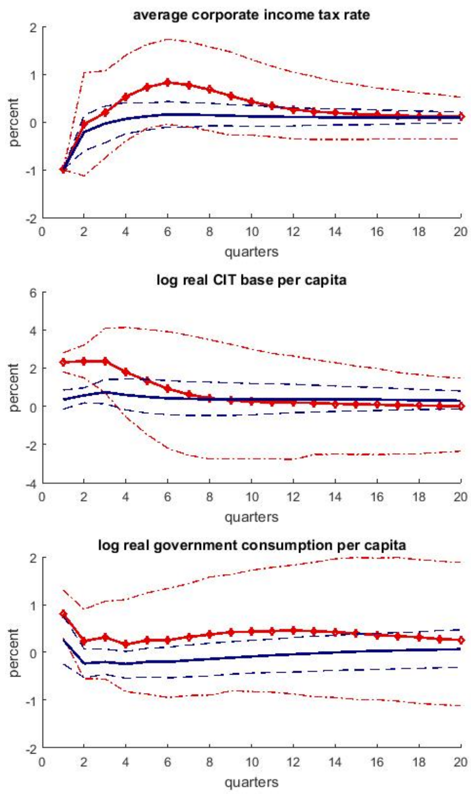


Figure 3 shows responses of selected variables to a 1 percentage point cut in average corporate income tax rate(ACITR). The cut leads to a large and significant increase in corporate income tax base in the short-run. The output effects of ACITR cuts are again significant and substantial for the first 6 quarters. Combining the results for ACITR and the corporate income tax base, the cut in ACITR appear to be self-financing even in the longer run. Again, these results are qualitatively similar to what Mertens and Ravn(2013) found for the United States.

Figure 3: Impulse responses to a 1 percentage point cut in average corporate income tax rate



3.3 Empirical results

This section presents the main empirical results. As the narrative approach identifies fiscal changes not motivated by stabilizing the economy over the business-cycle, I use the narrative shocks as direct measures of austerity and run the following panel regression:

$$\Delta Y_{it} = \alpha_i + \beta_t + \gamma_2 \epsilon_{it}^T + \theta_2 D_{it} \epsilon_{it}^T + \omega_{it} \tag{18}$$

where Y_{it} is log of GDP per capita, ϵ_{it}^T tax austerity shocks from Dabla-Norris and Lima(2018) and D_{it} debt regime dummy that equals 1 in a state of high-debt and 0 otherwise. Results are reported for all tax changes, tax rate changes and tax base changes, respectively.

Table 2 presents results for equation 18 using model-based definition of high-debt regime. As expected, fiscal consolidation programs based on tax increases slow down output growth. However, when the economy is in high-debt regime, an additional expansionary effect of tax consolidations is present. This additional effect is driven entirely by changes in tax rate: the second column shows that a 1 percentage point increase in taxation by raising tax rates is associated with a 54 basis point decrease in output at all times, and a 75 basis point increase in output during "bad times". Both of these effects are statistically significant. Importantly, the net effect of a tax-hike by raising tax rate during bad times is expansionary.

Table 2: Expansionary Austerity: Narrative shocks

	GDP Growth Coef./SE	GDP Growth Coef./SE	GDP Growth Coef./SE
Tax Shock	-0.6023***		
	(0.1685)		
Tax Shock*Dummy	0.2586		
	(0.2892)		
Tax Rate Shock		-0.5403***	
		(0.1871)	
Tax Rate Shock*Dummy		0.7564**	
		(0.3805)	
Tax Base Shock			-0.2630
			(0.2174)
Tax Base Shock*Dummy			-0.3782
			(0.3592)
Sample Size	1215	1215	1215

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: All regressions include a constant and a full set of country and year dummies. Standard errors are cluster-robust.

Table 3 presents the same set of empirical results using an alternative definition of high-debt regime: D_{it} switches to 1 if the country's debt to GDP ratio is above the 80 percentile of its historical empirical distribution. This is a definition commonly used in the literature, such as Perotti(1999), and it can be thought of as a Reinhart and Rogoff(2008) type debt trigger. Again, when the economy is in high-debt regime, an additional expansionary effect is present. The additional effect of tax consolidations is driven entirely by changes in tax rate: the second column shows that a 1 percentage point increase in taxation by raising tax rates is associated with a 63 basis point decrease in output at all times, and a 57 basis point increase in output during "bad times". Both of these effects are statistically significant. Although the net effect of a tax-hike by raising tax rate during bad times is not expansionary under this alternative definition of high-debt regime, it is hardly contractionary in terms of output losses.

Table 3: Expansionary Austerity: Narrative shocks, alternative regime

	GDP Growth Coef./SE	GDP Growth Coef./SE	GDP Growth Coef./SE
Tax Shock	-0.7321***		
	(0.1972)		
Tax Shock*Dummy	0.4207*		
	(0.2740)		
Tax Rate Shock		-0.6310***	
		(0.2240)	
Tax Rate Shock*Dummy		0.5742**	
		(0.3230)	
Tax Base Shock			-0.6051**
			(0.3176)
Tax Base Shock*Dummy			0.2930
			(0.3806)
Sample Size	1215	1215	1215

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: All regressions include a constant and a full set of country and year dummies. Standard errors are cluster-robust.

In sum, using quarterly narrative data on fiscal consolidations, I find that austerity programs which increase tax rates during bad times do not necessarily cause output losses, and can be potentially expansionary. This finding is robust to how one defines the critical debt level beyond which an anti-Keynesian effect is expected to kick in.

4 Testing the EFC hypothesis with VAR structural shocks

In this section, I test the EFC hypothesis empirically by using structural shocks estimated from an identified VAR as an indirect measure of fiscal austerity. Proxy structural VAR, a relatively new empirical methodology in this literature, is employed to estimate the structural shocks. I discuss data and the PVAR identifiation scheme before presenting main empirical results with two alternative definitions of high-debt regime.

4.1 data

My sample consists of annual data for 17 OECD countries between 1978 and 2009[1]. These countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Portugal, Spain, Sweden, United Kingdom and United States. Quarterly data would have increased the precision of my estimates and allowed for the estimation of a separate structural VAR for each country, but spending and tax revenue data are not available at quarterly frequency for a large fraction of the country-years I considered.

Y_t and T_t are *Gross Domestic Product* and *Tax Revenue* from OECD statistics. G_t is *Government Expenditure* from the recently constructed IMF Historical Public Finance Dataset described in Mauro et al.(2015), the most comprehensive source of fiscal flows and stocks to date, where the debt-to-GDP ratios are also taken from. All three variables in the SVAR are in logs, per capita, real and in dollars. The narrative fiscal series are from Devries et al(2014), where the authors document the exact sources, methodology and construction of these discretionary changes in taxes and spending, drawing extensively on policy documents and reports to identify the motivation of such changes. Guajardo, Leigh and Pescatori(2014) use this dataset to study expansionary fiscal contractions.

[1] Final regressions are for the years 1981-2009, since I estimated the VARs with two lags and variables are first-differenced.

4.2 Structural VAR specification

Since my time series is short relative to the number of parameters, I consider the following panel vector auto-regression(PVAR) model for $X_{i,t} = [T_{i,t}, G_{i,t}, Y_{i,t}]'$, after taking out country specific deterministic time trend and demeaning $X_{i,t}$:

$$X_{i,t} = A_1 X_{i,t-1} + ... + A_p X_{i,t-p} + u_{i,t} \tag{19}$$

This specification allows me to pool estimates of the lag coefficient matrices in the VAR and hence to reduce the total number of parameters estimated, while still having country-specific reduced form shocks.[2] Let $u_{i,t} = [u^T_{i,t}, u^G_{i,t}, u^Y_{i,t}]$ be reduced-form shocks and $\epsilon_{i,t} = [\epsilon^T_{i,t}, \epsilon^G_{i,t}, \epsilon^Y_{i,t}]$ be structural shocks, the following system is estimated for each country i:

$$u^T_{i,t} = \theta_G \sigma_G \epsilon^G_{i,t} + \theta_Y u^Y_{i,t} + \sigma_T \epsilon^T_{i,t} \tag{20}$$

$$u^G_{i,t} = \gamma_T \sigma_T \epsilon^T_{i,t} + \gamma_Y u^Y_{i,t} + \sigma_G \epsilon^G_{i,t} \tag{21}$$

$$u^Y_{i,t} = \zeta_T u^T_{i,t} + \zeta_G u^G_{i,t} + \sigma_Y \epsilon^Y_{i,t} \tag{22}$$

Here the structural errors satisfies $E[\epsilon_{i,t}] = 0$ and $E[\epsilon_{i,t}\epsilon'_{i,t}] = I$.

I discuss the PVAR identification strategy proposed by Mertens and Ravn(2014) for this system, which is based in part on assumptions from Blanchard and Perotti(2002). In the later, identification involves imposing certain values on some parameters in the system above. First and foremost, because of decision and recognition lags, it is presumed that discretionary responses of spending to cyclical movements of output is unlikely, at least at quarterly frequency. Hence, $\gamma_Y = 0$. Second, one remains agnostic about whether spending or tax decisions come first. This means one of θ_G and γ_T is set to zero and the other can be estimated. It turns out that the answer doesn't depend much on which one is set to zero and I have $\gamma_T = 0$. Finally, θ_Y, the elasticity of tax revenue with respect to output, is calibrated to OECD estimates(See Giorno et al.(1995) for details of the calibration procedure). For instance, θ_Y is set to 2.08 for the case of the United States. The following decomposition is used in the calibration of θ_Y:

[2] Panel VAR estimation is carried out with Abrigo and Love(2015)'s package in STATA.

Let B be the tax base and all variables are in log levels. θ_Y consists of a sum, across all tax types, of the elasticity of each tax with respect to its tax base times the elasticity of its tax base with respect to output, weighted by the share of the tax in total tax revenue:

$$\theta_Y = \frac{dT}{dY} = \frac{dT}{dB}\frac{dB}{dY} = \Sigma_i \frac{\frac{dT_i}{T_i}}{\frac{dB_i}{B_i}} \frac{\frac{dB_i}{B_i}}{\frac{dY}{Y}} \frac{T_i}{T} = \Sigma_i \eta_{T_i,B_i} \eta_{B_i,Y} \frac{T_i}{T} \tag{23}$$

The response of tax to output in this setting encompasses stabilization policy, so long as the policy is pre-ordained in the tax code: for instance, an extension of the duration of unemployment insurance when the economy is in a downturn.

The system in 20 - 22 can be written in matrix form as:

$$\begin{bmatrix} 1 & 0 & -\theta_Y \\ 0 & 1 & -\gamma_Y \\ -\zeta_T & -\zeta_G & 1 \end{bmatrix} \begin{bmatrix} u_t^T \\ u_t^G \\ u_t^Y \end{bmatrix} = \begin{bmatrix} \sigma_T & \theta_G \sigma_G & 0 \\ \gamma_T \sigma_T & \sigma_G & 0 \\ 0 & 0 & \sigma_Y \end{bmatrix} \begin{bmatrix} \epsilon_t^T \\ \epsilon_t^G \\ \epsilon_t^Y \end{bmatrix} \tag{24}$$

or more compactly, $Au_t = D\epsilon_t$. Therefore:

$$u_t = A^{-1} D\epsilon_t = B\epsilon_t \tag{25}$$

$$E[u_t u_t'] = BE[\epsilon_t \epsilon_t']B' = BB' \tag{26}$$

Since the sample analogue of $E[u_t u_t']$ is a three-by-three covariance matrix, it provides six independent identification restrictions. There are nine parameters in the original system, so the structural VAR will be just-identified if one imposes these three additional restrictions above.

Mertens and Ravn(2014) provides identification restrictions by utilizing information from available narrative series of exogenous fiscal shocks. The original purpose of this approach was to reconcile the marked differences between estimates of the fiscal multiplier from the SVAR approach and the narrative approach. Let m_t be the narrative tax shocks, and the assumptions are as follows:

$$E[m_t \epsilon_t^T] = \phi \tag{27}$$

$$E[m_t \epsilon_t^G] = 0 \tag{28}$$

$$E[m_t \epsilon_t^Y] = 0 \tag{29}$$

In words, the narrative tax shocks are positively correlated with the structural tax shocks, but uncorrelated with structural spending and output disturbances.

Hence,

$$E[u_t m_t] = E[B\epsilon_t m_t] = E[B \begin{bmatrix} \phi \\ 0 \\ 0 \end{bmatrix}] = \phi \begin{bmatrix} \beta_{11} \\ \beta_{21} \\ \beta_{31} \end{bmatrix} \tag{30}$$

Thus, two independent identification restrictions are obtained:

$$\begin{bmatrix} \beta_{21} \\ \beta_{31} \end{bmatrix} = \phi^{-1} E[m_t \begin{bmatrix} u_t^G \\ u_t^Y \end{bmatrix}] = \beta_{11} E[m_t u_t^T]^{-1} E[m_t \begin{bmatrix} u_t^G \\ u_t^Y \end{bmatrix}] \tag{31}$$

This means two out of the three parameter restrictions in the Blanchard and Perotti(2002) system can be replaced. In particular, the calibrations of θ_Y is considered problematic and is no longer imposed. $\gamma_Y = 0$ is still imposed. The PVAR system is just-identified with eight parameters and eight independent identification restrictions. The structural shocks, $\epsilon_{i,t} = [\epsilon_{i,t}^T, \epsilon_{i,t}^G, \epsilon_{i,t}^Y]$, is estimated for every country i and retrieved for use as an indirect measure of austerity.

As an illustration, I plot the structural fiscal shocks for Denmark in figure 4 in the appendix. Between 1983 and 1986, the country implemented a large-scale austerity program involving actions on both the expenditure side, such as limits on public sector wages and social payments, and the revenue side, such as hikes in social security contributions, taxation of higher-yielding pensions and an increase in the maximum tax rates. The program was announced in 1982 with the formation of a new coalition government. As can be seen, the estimated structural tax and spending shocks speak to what happened during the period relatively well.

4.3 Empirical results

This section presents a second set of main empirical results. As the structural shocks from the PVAR in the last section is uncorrelated with output, they are used as a measure of austerity. In section 3, the Dabla-Norris and Lima(2018) narrative dataset only covers changes in taxation. This measure of austerity covers both changes to taxation and government spending. The following set of panel regression is estimated:

$$\Delta Y_{it} = \alpha_i + \beta_t + \gamma_1 \epsilon_{it}^G + \gamma_2 \epsilon_{it}^T + \omega_{it} \tag{32}$$

$$\Delta Y_{it} = \alpha_i + \beta_t + \gamma_1 \epsilon_{it}^G + \theta_1 D_{it} \epsilon_{it}^G + \gamma_2 \epsilon_{it}^T + \theta_2 D_{it} \epsilon_{it}^T + \omega_{it} \tag{33}$$

where ΔY_{it} is output or consumption growth. The first regression looks at the general relationship between output/consumption and the structural fiscal shocks, and the second regression interacts the shocks with regime dummies, D_{it}, to explore the presence of anti-Keynesian effects of austerity programs. D_{it} is a debt regime dummy that equals 1 in a state of high-debt and 0 otherwise.

Table 4: Expansionary Austerity: Mertens-Ravn shocks

	Consumption Growth	Consumption Growth
	Coef./SE	Coef./SE
Tax Shock	-0.6821***	-0.8019**
	(0.1450)	(0.3997)
Spending Shock	0.2552***	0.3700**
	(0.0796)	(0.1598)
Tax Shock*Dummy		0.7720
		(0.9220)
Spending Shock*Dummy		-0.6880***
		(0.2174)
Constant	1.0190	0.8143
	(0.7701)	(0.9210)
Sample Size	116	116
R^2	0.5224	0.5363

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: All regressions include a full set of country and year dummies. Standard errors are cluster-robust.

Table 4 and table 5 present results for equations 32 and 33 using the model-based definition of high-debt regime. In general, increasing taxes or decreasing government spending reduces output and consumption, as expected. When the economy is in the high-debt regime, an additional expansionary channel of fiscal austerity is present: increasing taxes or decreasing government spending actually boosts output/consumption via this channel. This additional anti-Kenyesian channel is statistically significant for the effect of spending on consumption and for the effect of taxation on output. In table 4, cutting government spending by 1 percentage point decreases consumption growth by 37 basis point on average, but boosts it by 69 basis point in "bad times". Fiscal consolidation programs based on government spending cuts actually increases consumption when the economy is in the high-debt regime. In table 5, increasing taxes by 1 percentage point lowers output growth by 75 basis point, but boosts it by 72 basis point in "bad times". Fiscal consolidation programs based on tax hikes actually do not entail output losses when the economy is in the high-debt regime.

Table 5: Expansionary Austerity: Mertens-Ravn shocks

	Real GDP Growth	Real GDP Growth
	Coef./SE	Coef./SE
Tax Shock	-0.5839***	-0.7488***
	(0.1932)	(0.2473)
Spending Shock	0.1460	0.1595
	(0.2512)	(0.1598)
Tax Shock*Dummy		0.7209***
		(0.2984)
Spending Shock*Dummy		-0.2064
		(0.4394)
Constant	0.8717***	0.8143
	(0.2252)	(0.9210)
Sample Size	105	105
R^2	0.8094	0.8149

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: All regressions include a full set of country and year dummies. Standard errors are cluster-robust.

Table 6 presents the same set of empirical results for consumption, using the alternative definition of high-debt regime. Under this definition, the additional anti-Kenyesian channel is statistically significant for the effect of taxation on consumption. Increasing taxes by 1 percent lowers consumption growth by 1 percent, but boosts it by 1 percent in "bad times". Fiscal consolidation programs based on tax hikes actually do not entail consumption losses when the economy is in the high-debt regime.

Table 6: Expansionary Austerity: Mertens-Ravn shocks, alternative regime

	Consumption Growth Coef./SE	Consumption Growth Coef./SE
Tax Shock	-0.6821***	-1.0382***
	(0.1450)	(0.3084)
Spending Shock	0.2552	0.2167***
	(0.0796)	(0.0558)
Tax Shock*Dummy		0.9925***
		(0.3606)
Spending Shock*Dummy		0.2603
		(0.2310)
Constant	1.0190***	0.8143
	(0.7701)	(0.9210)
Sample Size	105	116
R^2	0.5224	0.5497

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: All regressions include a full set of country and year dummies. Standard errors are cluster-robust.

In sum, using structural shocks recovered from a PVAR, I find that fiscal austerity programs do not necessarily entail significant output or consumption losses when the economy is under heavy debt burdens. These findings are generally in line with results from narrative data.

5 Conclusion and Caveats

In this paper, I provide some limited empirical evidence in support of the Expansionary Fiscal Contraction(EFC) hypothesis: when a country's debt level is perilously high, tax-based austerity programs could be expansionary(increase output or consumption), or at least not contractionary. This paper contributes to the empirical literature of this topic by employing a model-based definition of high-debt regimes and providing two alternative definitions of austerity: one definition is based on a new source of cross-country narrative fiscal data and the other is based on structural shocks estimated from a proxy SVAR.

These results should be interpreted with caution for a few reasons: first, the sample includes only a selected number of OECD countries for a sample period between 1978 and 2014 as my choice of sample is constrained by available sources of narrative fiscal data. Hence the results may not generalize to Emerging Markets and Developing Economies(EMDEs). Second, my empirical results for consumption is robust to alternative definitions of high-debt regime but not to alternative definitions of austerity. In my empirical results for GDP growth, coefficient estimates for government spending is not significant. Finally, austerity programs are often accompanied by other structural reforms. which this paper does not examine. In sum, empirical results in this paper should not be readily interpreted as suggesting that fiscal austerity is always the appropriate course of action whenever debt level is high.

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A. Description of algorithm for panel PVAR

1. Import data for all countries and transform data appropriately to ensure stationarity.
2. For each country, estimate the first step by an OLS estimator as in equation 1. Save residuals $u_{i,t}$.
3. Estimate structural parameters of the panel proxy SVAR using $u_{i,t}$s in the second step and $m_{i,t}$s as input, imposing identification restrictions in Mertens and Ravn(2013).
4. Compute impulse responses functions for each country using country-specific reduced form parameters $\Omega_i^d = [A_{0,i}, A_{1,i}, ..., A_{p,i}]$ and common structural parameters in the matrix B.
5. Compute average impulse response function. Compute the confidence intervals of the average IRF using a wild bootstrap procedure designed specifically for our setting.

B. Computational Appendix

In this section, I describe the algorithm used to compute bootstrap confidence intervals of our average impulse response function. These CIs can be though of as an average of the bootstrap CIs for each individual country. The methodology extends Mertens and Ravn(2013) to a panel setting where I pool estimates of structural parameters.

a) Bootstrap iteration j

1) Loop over country i

i. Create random vector v_i of length $T_i \times 1$, which takes values 0.5 or -0.5 with probability each (T_i is number of time observations in country i)

ii. Create new residual vector $u_i' = u_i \times v_i$

iii. Create new dependent variable vector $Y_i' = A_i \times X_i + u_i'$, where $A_i \times X_i$ is the VAR model estimated in the first step for country i

2) Assemble new dependent variable Y' by combining the country-specific vectors Y_i

3) Run model with new dependent variable Y' and original proxies M

i. Estimate VAR, country by country (1st step)

ii. Narrative identification, pooling across countries (2nd step)

iii. Compute average IRF

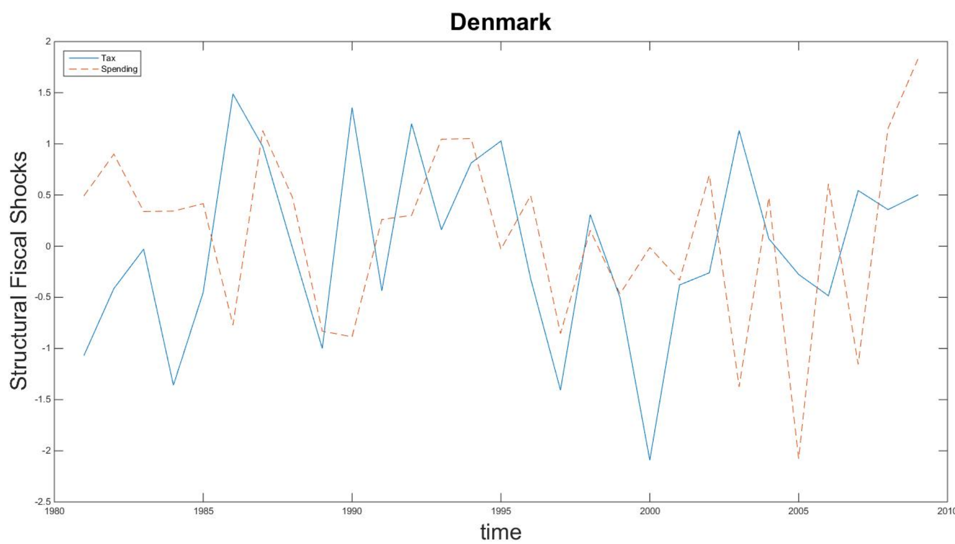
4) Store IRF of iteration j

b) Run for B iterations

c) Get the 5th and 95th percentiles of the IRF distribution

C. Additional figures

Figure 4: Exogenous changes in tax and spending in Denmark



D. Additional tables

Table 7: Calibration of the Sutherland Model for OECD Countries

	Parameter(%)					
	r	θ	T	σ	U	L
AUS	9.2	1.28	2.47	2.07	80	-80
AUT	5.57	1.3	2.49	1.26	60	-60
BEL	7.44	1.3	7.46	3.59	60	-60
CAN	7.88	1.28	7.92	3.17	80	-80
DNK	6.53	1.31	6.69	3.14	80	-80
FIN	6.9	1.3	11.43	3.48	60	-60
FRA	7.84	1.29	1.12	1.36	60	-60
DEU	6.14	1.3	3.68	1.82	60	-60
IRE	8.42	1.31	7.39	4.44	60	-60
ITA	6.58	1.28	11.98	3.33	60	-60
JPN	2.81	1.25	1.98	3.47	80	-80
NLD	6.4	1.29	5.64	2.11	60	-60
PRT	5.69	1.33	3.53	2.24	60	-60
ESP	9.42	1.28	5.44	2.98	60	-60
SWE	7.14	1.27	5.75	4.67	80	-80
GBR	8.06	1.3	2.54	3.22	80	-80
USA	7.24	1.32	1.84	2.54	80	-80

This table gives numerical values of parameters I used to calculate B^*, the debt level that defines the regime dummies in section 5.