



ISSN 2443-8022 (online)

Fiscal Policy after the Crisis

Workshop Proceedings

Edited by Matteo Salto

DISCUSSION PAPER 035 | JULY 2016

EUROPEAN ECONOMY



Economic and
Financial Affairs

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Luxembourg: Publications Office of the European Union, 2016

KC-BD-16-035-EN-N (online)
ISBN 978-92-79-54442-2 (online)
doi:10.2765/340618 (online)

KC-BD-16-035-EN-C (print)
ISBN 978-92-79-54443-9 (print)
doi:10.2765/75304 (print)

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European Commission

Directorate-General for Economic and Financial Affairs

Fiscal Policy after the Crisis

Proceedings of the Public Finance Workshop organised by the Directorate-General for Economic and Financial Affairs in Brussels on 19 January 2016

Edited by Matteo Salto

Abstract

This paper presents the proceedings of the annual Public Finance Workshop organised by the Directorate-General for Economic and Financial Affairs in Brussels on 19 January 2016 in relation with the publication of its Public Finance in EMU 2015 Report. After the double-dip recession between 2009 and 2013, growth is gradually returning to the EU and the euro area but it is still subject to downside risks. On the nominal side, both inflation and interest rates remain very low, thereby curtailing the stabilisation function of monetary policy. After years of fiscal consolidation, budget deficits have been reduced significantly in most Member States. Nevertheless, the crisis has taken its toll on the societies of several Member States and left us with the legacy of high public-debt ratios and increased social challenges. The workshop discusses the best options for fiscal policy in such an environment. It was organised in two sessions: Session 1: "Fiscal policy in a low-inflation context", and Session 2: "Fiscal policy after the crisis". The proceedings display the high quality contributions that were presented in each of these sessions and the discussions that followed.

JEL Classification: C32, C54, E22, E32, E60, E62, F45.

Keywords: DSGE, fiscal consolidation, fiscal policy, impulse response functions, inflation, public debt, public finances, public investment, public wage bill, VAR, zero lower bound.

Acknowledgements: The workshop was coordinated by Julia Lendvai organized under supervision of Matteo Salto and under the direction of Gilles Mourre and Lucio Pench. Francisco De Castro coordinated the selection of the papers before the workshop. Administrative support was provided by Maria Stampouli, Patrick Wynincx and Kristine de Winter. Maria Stampouli was responsible for layout support.

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INTRODUCTION

OPENING REMARKS AND WELCOME BY MARCO BUTI (ECFIN): MAIN HIGHLIGHTS

Firstly, I would like to welcome everybody here today to our workshop on "Fiscal Policy after the Crisis" and to thank you all for coming.

This workshop, organised on a yearly basis in relation with the Public Finance Report, has now become a well set tradition. It is a unique opportunity for us to share, discuss and debate topical issues with a very broad audience. Indeed, among the attendance present here today are not only members from international, European and national institutions, but also representatives from the academic world as well as the private sector.

The theme this year is fiscal policy after the crisis: with a special focus on the link between low inflation and public finances; as well as other selected issues relevant in the current context, such as public debt reduction, the role of public investment and the link between fiscal consolidation and inequality.

After the double-dip recession between 2009 and 2013, growth is gradually returning to the EU and the euro area but it is still subject to downside risks. Growth rates remain subdued and are also overshadowed by downside risks (cf. emerging market crisis and geopolitical tensions). On the nominal side, both inflation and interest rates remain very low, thereby curtailing the stabilisation function of monetary policy. After years of fiscal consolidation, budget deficits have been reduced significantly in most Member States. Nevertheless, the crisis has taken its toll on the societies of several Member States and left us with the legacy of high public-debt ratios and increased social challenges.

In normal times Escolano and Gaspar show that a policy of gradual debt ratio reduction via a constant small surplus is optimal in order to smooth taxes inter-temporally. However, in the current economic and social context, the short-run stabilisation role of fiscal policy has become more prominent in the monetary union, beyond its usual objective of ensuring long-run sustainability. Specifically, the fact that monetary policy is running out of its usual stabilisation instruments and in view of the persistently sluggish growth rates across most of the euro area, there is scope for fiscal policy to become more active in the stabilisation of large euro-area-wide symmetric shocks. This may also go beyond the working of automatic fiscal stabilisers.

One of the most important factors of sluggish growth is low domestic demand and in particular also the investment gap that characterises the EU economies. Recognising this, the Juncker Commission has defined –beyond fiscal responsibility– the re-launch of investment as one of its key policy priorities. Last year, a EUR 315 billion Investment Plan was put in place with the aim to unlock investment potential and thereby to kick-start jobs and growth in Europe.

Of course, balancing between the objectives of fiscal sustainability and economic stabilisation may entail trade-offs – as is currently the case in various euro area Member States. The importance of closer fiscal policy coordination among Member States has thereby also increased further.

The legacy of the crisis and the macro-economic context also pose a number of other challenges to the design of fiscal policy. In particular, low inflation and low growth has an impact on fiscal sustainability thereby limiting the available fiscal space. In addition, inflation uncertainty makes the conduct of fiscal policy more difficult both directly, by making budgetary planning more challenging and also indirectly, by modifying the usual transmission channels of fiscal policy.

This is analysed in the papers by End et al. and by Pappa et al. While of a different nature, both papers indicate that in times of deflation or low inflation, fiscal consolidation poses more challenges because it leads to increases in debt ratios and adversely affects fiscal performance.

Low inflation was also explored in the Public Finance Report 2015 where we have shown that the impact of low inflation on the budget can be sizeable. We then made the link with fiscal surveillance tools and showed that unexpectedly low inflation distorts the picture of fiscal effort delivered by countries. In particular, in circumstances in which inflation turns out lower than expected, the achievement of budgetary objectives may be more difficult since revenues and expenditures will typically be impacted differently by the inflation surprise.

Low inflation also impacts the different measures of fiscal effort under the SGP in non-trivial ways. But the surveillance framework leaves enough room for flexibility to take low inflation into account in the assessment of the breach of the SGP criteria. To allow for this kind of flexibility in fiscal surveillance, it is crucial that we understand well the link between inflation and fiscal policy in the current environment.

The topics of the conference today will address fiscal policy in the current context from different angles. The morning session will focus on fiscal policy in a low-inflation environment while in the afternoon, the aspects of debt reduction, public investment and inequality will be covered.

As I just explained, today's contributions feed very well into DG ECFIN's analytical and policy work-streams. So I am very much looking forward to the presentations and the ensuing stimulating discussions. Let me also sincerely thank our speakers for their work in adding to these rich and most policy-relevant of debates.

SESSION I – FISCAL POLICY IN A LOW INFLATION CONTEXT

Fiscal Consolidation in a Disinflationary Environment: Price vs. Quantity-Based Measures, by Evi Pappa, Rana Sajedi and Eugenia Vella (European University Institute)

An important feature of the current economic conditions in the EU, which challenges the design and implementation of macroeconomic policy, is inflation uncertainty. With monetary policy at the zero lower bound, and inflation well below its target, a key issue for policy makers is the effect this has on the transmission of fiscal policy. We aim to address this question, in particular comparing the effects of price-based and quantity-based fiscal instruments. In this paper we focus on the public wage bill, and consider a model of a monetary union in which the government can consolidate their debt through reductions in the public wage or public employment. We find that in both cases the low-inflation environment eliminates the expansionary effects of the reduction in the public wage bill for the private sector. The drag in economic activity is substantially amplified in the low inflation environment, with increased debt-to-GDP levels during the consolidation process.

Selected comments on the discussion, by Raf Wouters (National Bank of Belgium)

The model is rich and interesting and brings new insights on the impact of fiscal consolidation on the labour market. In particular, the model shows that fiscal consolidation based on wages (or prices) is more efficient for debt reduction than consolidation strategies based on labour shedding. In this respect fiscal consolidation is less costly when the public sector is not efficient. The model would benefit by some technical developments, though. Moreover, it would be interesting to empirically verify the magnitude of the transmission channels of fiscal policy proposed in the model.

Public finances and inflation: the case of Spain, by Pablo Hernández de Cos, Samuel Hurtado, Francisco Martí and Javier J. Pérez (Banco de España)

We empirically explore the influence of inflation on fiscal variables in the short-, medium- and long-run, for the case of the Spanish economy, in particular to draw policy lessons for the design of the ongoing process of rebalancing of fiscal accounts. Indeed, while Spanish public finances are in a correction path, still high government deficits and debt levels are registered by the different public administrations. In addition, the effectiveness of a number of structural fiscal measures implemented is contingent on the future path of inflation, and the nature of inflation shocks/regimes. In this paper, we look at these issues through the lenses of: (i) the government budget constraint to assess the influence of inflation on changes in public debt; (ii) accounting decompositions of nominal revenue and expenditure items into their real and price parts; (iii) a large-scale macro econometric model that contains a detailed fiscal policy block; (iv) a long-run accounting model on pension expenditure (along the lines of the works of the AWG).

Selected comments on the discussion, by Werner Roeger (European Commission)

The paper is motivated by the current low-inflation environment. It makes the relevant point that, while such low inflation negatively affects the dynamics of government debt, the source of the negative inflation shock influences how such shock impacts on the budget. The paper compares a mark-up reduction shock and oil price reduction shock. These are two supply shocks which lower inflation, but have opposite effects on the debt ratio. While I concur with these results, the paper should also analyse the case for a negative demand shock, which could be the cause of the current low-inflation environment in Spain.

Deflation and Fiscal Aggregates: Sailing with No Wind - *Public Finances in Deflation Quagmire*, by Nicolas End, Sampawende Tapsoba, and Gilbert Terrier (International Monetary Fund)

In times of deflation or low inflation, fiscal consolidation turns more challenging, unless indexation mechanisms are fully effective. First, negative inflation leads to increases in debt ratios, as GDP deflators turn negative. Second, low or negative inflation rates adversely affect fiscal performance: tax collections are undermined and, with downward rigidities in expenditure, fiscal deficits tend to worsen. Evidence from 21 countries over a period of more than 150 years suggests that recessionary deflations are especially dangerous for fiscal sustainability. Moreover, with more elastic tax bases and automatic expenditure under asymmetric indexation mechanisms, fiscal accounts may be more at risk in modern times than in the past.

Selected comments on the discussion, by Martin Larch (European Commission)

The paper is a thorough attempt to extract regularities on the relation between debt and inflation from data spanning more than 150 years. In particular it shows that while low inflation has no major impact on debt and deficit developments, high inflation or deflation do have an impact. Moreover it confirms the asymmetry of behaviour of debt along the cycle, which is known from the fiscal reaction function literature: the increase in primary expenditures in the good part of the cycle implies that reductions in the debt ratio during booms are smaller than its increases during recessions. Notwithstanding the interest of this type of analysis, it is difficult to derive policy conclusions, in particular in relation to the fact that the analysis does not disentangle the effects of the economic environment from the effects of discretionary policy decisions.

SESSION II – FISCAL POLICY AFTER THE CRISIS

Optimal Debt Policy under Asymmetric Uncertainty, by Julio Escolano and Vitor Gaspar
(International Monetary Fund)

The surge of the public debt-to-GDP ratio in advanced economies following the 2008 global financial crisis was unprecedented within the post-WWII period—but not from a longer-term historical standpoint. For more than two centuries, the debt ratios of the largest economies of the time (the United States and the United Kingdom) show rare but recurrent large surges due to wars, financial crises and economic downturns, followed by gradual but persistent declines over long periods. We show that this policy of gradual debt ratio reduction in normal times is optimal in the presence of debt shocks with a skewed distribution –as we argue is the case– if the government seeks to smooth taxes inter-temporally and minimize the present value of dead-weight loss.

Selected comments on the discussion, by Carlo Favero (Bocconi University)

The paper is very interesting and brings new insights on optimal debt policy. The paper answer the question of what is the optimal debt policy with tax smoothing and asymmetric shock to the debt ratio. It shows that some surplus is necessary under this condition but that tax smoothing does not imply debt stabilization. This result is crucially related to the assumption that the model does not include a drift in the evolution of debt. Even under this assumption, the feasibility of the optimal debt policy crucially depends on the possibility that debt ratios can continue to increase for very long time even at very high levels. That brings into question the necessity to better analyse the nature and characteristics of fiscal shocks.

Fiscal consolidation and inequality: a descriptive analysis, by Tim Buyse (University of Ghent)

The relationship between periods of fiscal tightening on the one hand and income inequality or poverty on the other, has only recently received increasing attention. An important gap remains regarding our understanding of the effects of fiscal adjustments on income (re)distribution. Recent studies on this topic use dummy variables to capture (the start) of a consolidation episode (Agnello and Sousa, 2014; Ball et al., 2013) or perform a panel analysis with yearly date, thereby neglecting the fact that subsequent years of fiscal tightening may belong to the same consolidation program (Woo et al., 2013).

Building on our previous work in Heylen et al. (2013), we analyse in this paper the relationship between the composition and design of well-defined periods of fiscal consolidation on the one hand and income inequality on the other. Based on a descriptive analysis of 45 periods of fiscal adjustment since 1981, we find little evidence that fiscal consolidation tends to raise inequality. On average during periods of consolidation, the net-GINI coefficient increased somewhat more than in non-consolidation periods. We especially identify GDP growth as an important driver of inequality, confirming the idea that higher growth rates tend to increase inequality, also during periods of fiscal adjustment. Composition of the adjustment package might also be important: expenditure-based consolidation packages seem to increase inequality less than income-based packages. The descriptive analysis contained in this paper is only a first step to try to understand the relationship between fiscal tightening and inequality. Further research will focus on (i) analysing the complete history of fiscal episodes in the OECD (that is, including also expansionary and neutral periods in the analysis) and (ii) improving the methodology to control for various determinants simultaneously.

Selected comments on the discussion, by Christian Kastrop (OECD)

The paper presents new fairly surprising evidence that market and net income inequality increase more in consolidation episodes that are accompanied by stronger GDP growth and are based on revenue increases rather than spending cuts. As the results are very novel, the authors should provide some robustness checks regarding the variables used to define consolidation episodes and inequality definitions. In this respect in particular the authors could adopt a more granular approach to income distribution in their future developments, along the lines of recent OECD work.

Economic Growth and Public and Private Investment Returns, by António Afonso and Miguel St. Aubynim (University of Lisbon)

We study the macroeconomic effects of public and private investment in 17 OECD economies through a VAR analysis with annual data from 1960 to 2014. From impulse response functions we find that public investment had a positive growth effect in most countries, and a contractionary effect in Finland, UK, Sweden, Japan, and Canada. Public investment led to private investment crowding out in Belgium, Ireland, Finland, Canada, Sweden, and the UK and crowding-in effects in the rest of the countries. Private investment has a positive growth effect in all countries; crowds-out (crowds-in) public investment in Belgium and Sweden (in the rest of the countries). The partial rates of return of public and private investment are mostly positive.

Selected comments on the discussion, by Narcissa Balta (European Commission)

The topic of the impact of the crisis on investments and the relation between public and private investment is very relevant. The paper shows that these relations are very much different by country. However, the paper could be improved on two accounts. First, discuss the possible instability of the parameters by sub-period, as the sample covers a time span which predates the euro and goes well into the crisis. Second, some discussion of the IRF estimates and the relative confidence bands should be introduced. Finally, in future developments the authors should consider incorporating in their estimates variables related to the behaviour of financial markets, which certainly have an influence on the decisions by private investors.

1. SESSION I: FISCAL POLICY IN A LOW INFLATION CONTEXT

1.1. FISCAL CONSOLIDATION IN A DISINFLATIONARY ENVIRONMENT: PRICE- VS. QUANTITY-BASED MEASURES⁽¹⁾

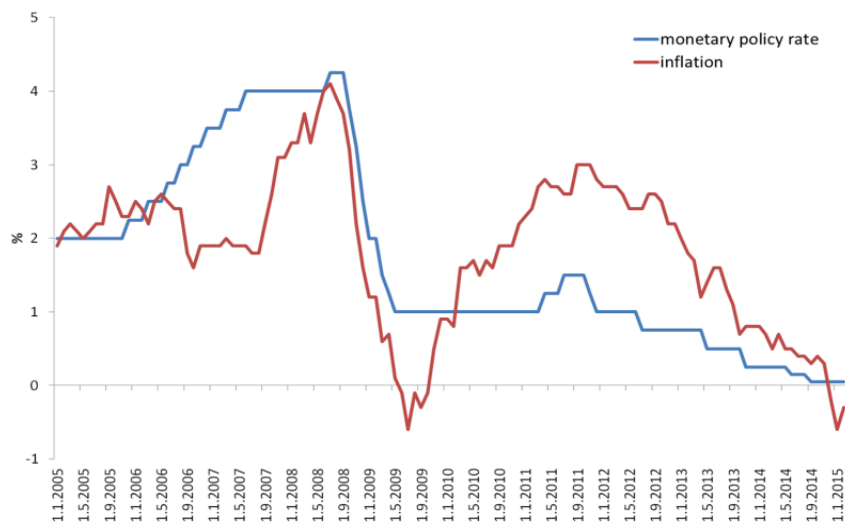
by Evi Pappa(*), Rana Sajedi(**) and Eugenia Vella(***)

1.1.1. Introduction

An important feature of the current economic conditions in the EU, which challenges the design and implementation of macroeconomic policy, is inflation uncertainty. With monetary policy constrained by the zero lower bound (ZLB henceforth), inflation in the euro area has remained below the ECB's medium-run objective for some time. While some recent studies have looked at the impact of the ZLB on fiscal policy, research on the differential impact of inflation on different budgetary items is limited. In this context, the aim of this paper is to examine the effects of alternative fiscal consolidation strategies to reduce the public wage bill, specifically comparing price-based measures and quantity-based measures, under different inflation environments.

As seen in Graph 1.1.1., since 2012, the inflation rate across the euro area has been trending downwards and still remains below the ECB's 2% target. At the same time, the scope for monetary policy easing has been limited, with nominal interest rates at the ZLB, and the effects of unconventional measures, such as the recent asset purchases, remaining uncertain.

Graph 1.1.1.: Inflation and interest Rates in the Euro Area



Source: ECB, Eurostat

(1) We are grateful for the comments of Raf Wouters and other participants in the conference "Fiscal policy after the crisis" organised by the European Commission. We would also like to thank Guilherme de Almeida Bandeira for excellent research assistance. The views expressed here in no way reflect those of the Bank of England.

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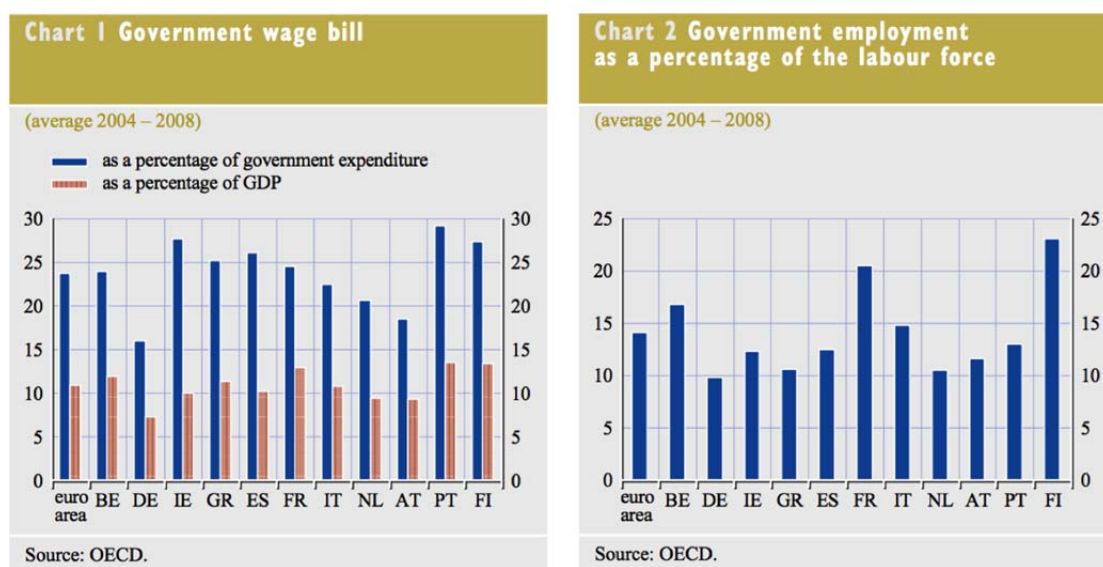
(**) European University Institute and Bank of England, rana.sajedi@bankofengland.co.uk

(***) Department of Economics, University of Sheffield. e-mail: e.vella@sheffield.ac.uk

This environment has important implications for fiscal policy. Firstly, low inflation is generally considered to make fiscal consolidation more difficult. Indeed, historically, periods of high inflation have been used to reduce debt-to-GDP ratios, for example in many western countries following both the First and Second World War (see Reinhart et al., 2015). From a theoretical point of view, low inflation reduces the growth in nominal GDP and, all else equal, raises deficit- and debt-to-GDP ratios. Debt dynamics would be left unchanged if nominal interest rates fall by the same magnitude as inflation, thus leaving real rates unchanged. Instead, when nominal rates have hit the ZLB, falling inflation leads to rising real interest rates making it more difficult to reduce government debt-to-GDP ratios.

Moreover, much of the literature, both theoretical and empirical, has found that fiscal multipliers are higher when monetary policy is constrained. In particular, Eggertsson (2011) found that the government spending multiplier goes from below 0.5, to around 2.3 at the ZLB, and that tax multipliers even change sign and become negative at the ZLB. Similar results are found in the studies of Christiano et al. (2011), Coenen et al. (2012) and De Long and Summers (2012). Empirically, Ilzetzki et al. (2013) corroborate these results, finding that government spending multipliers are substantially higher in countries operating under fixed exchange rates, which is another form of constrained monetary policy. Nakamura and Steinsson (2014) draw similar conclusions regarding the multiplier of military spending, although their analysis is not a direct comparison of different monetary regimes. Based on these principles, several papers discuss the potential role of fiscal stimulus in alleviating a ZLB crisis: Correia et al. (2013) suggest an alternative stimulus strategy to the use of government spending, based on consumption taxation, and Rendahl (2016) focuses on amplification effects in the labour market due to the ZLB and how expansionary fiscal policy can best exploit these. The converse of these arguments is that attempting to carry out fiscal consolidation in a liquidity trap can be very costly, and even self-defeating.

Graph 1.1.2.: Public Wage Bill and Public Employment before the Crisis



Source: Holm-Hadulla et al. (2010)

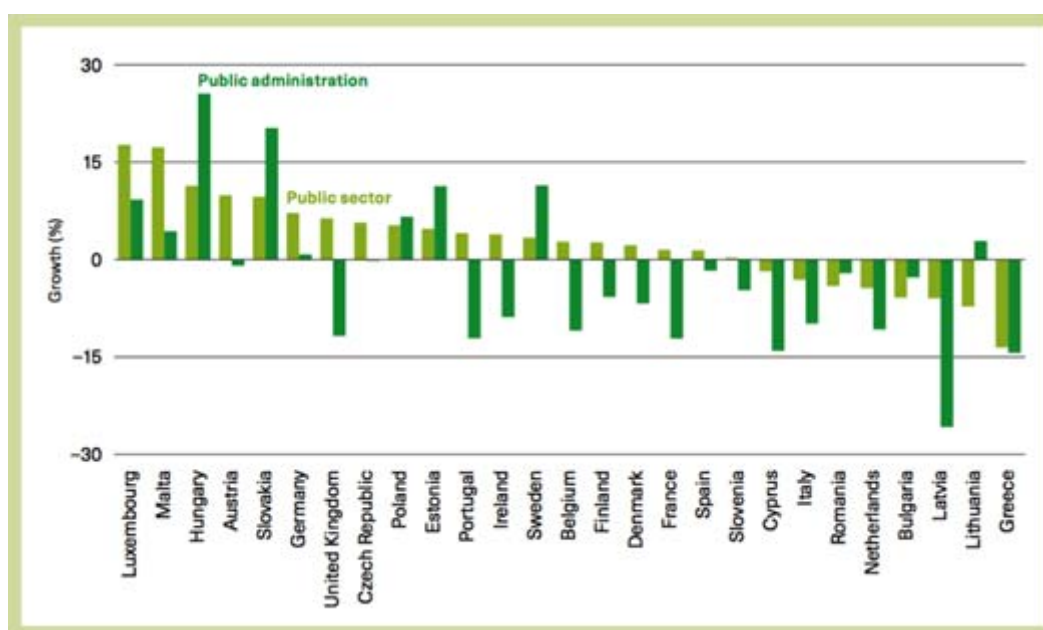
Another important way in which low inflation affects fiscal policy is the fact that inflation shocks can be expected to have a different impact, both in terms of size and timing, across different government revenue and expenditure categories. In line with the research highlighted above, Jalil

(2012) finds that the differences between the estimated multipliers of government spending and taxation can be explained by the differential response of monetary policy. Erceg and Linde (2013) find that the magnitude of the output contraction induced by spending-based consolidation is roughly three times larger when monetary policy is constrained by the ZLB than when it is unconstrained. They also find that, at the ZLB, a tax-based consolidation is less costly in the short-run than a spending-based consolidation, while the opposite is true when monetary policy is unconstrained. McManus et al. (2014) find that the ZLB has different effects on different fiscal consolidation instruments, and should therefore be considered when designing austerity packages.

One dimension of this comparison which has been overlooked is that the effectiveness of consolidation packages that focus on quantity-based measures instead of price-based measures may be different depending on the inflation environment. In that context, reducing the wage bill via cutting wages (price-based measure) or reducing public employees (quantity-based measure) may have a different budgetary impact depending on the inflation environment. This paper aims to uncover the potential effect of a low-inflation environment on these alternative consolidation strategies, with a particular focus on the public wage bill.

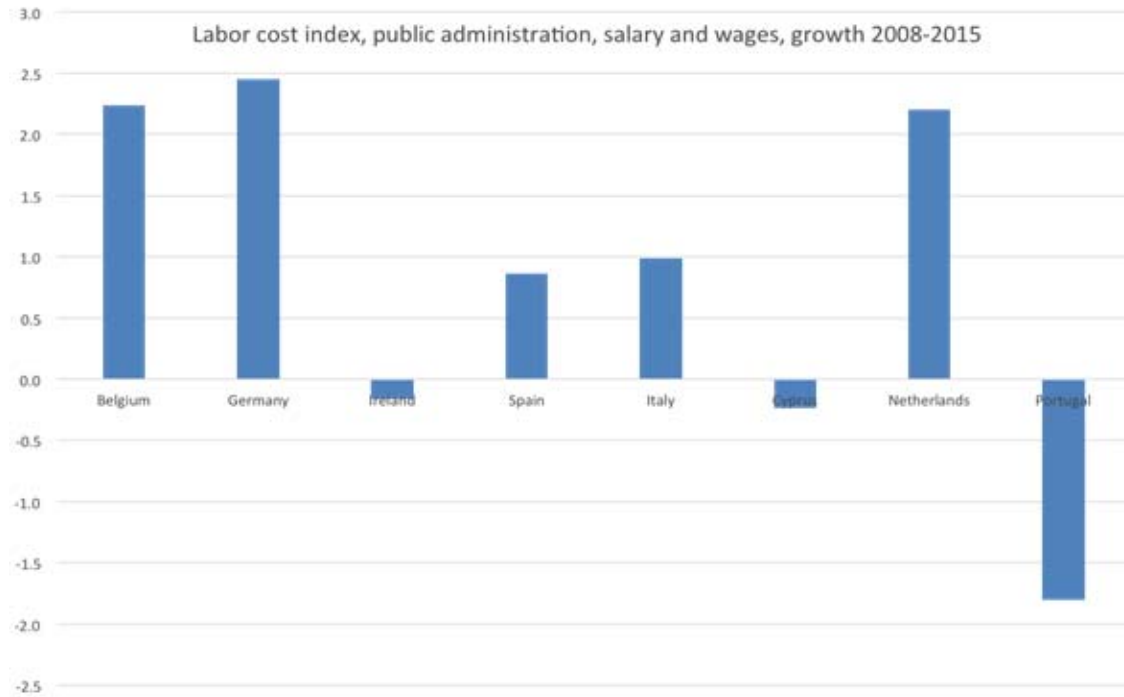
Recent austerity packages implemented in many European countries, like Greece and Spain, have placed special emphasis on the reduction of the public wage bill. According to data reported by Holm-Hadulla et al. (2010), shown in Graph 1.1.2., the government wage bill before the crisis accounted, on average, for almost a quarter of total public spending and more than 10% of GDP in the euro area. On average, almost 15% of the labour force in the euro area was employed by the public sector. Since the beginning of the crisis in 2008, most of these countries have been trying to cut government wage bills, by freezing wages and hirings, and cutting or retrenching specific indemnities or benefits. A recent report by Gama et al. (2015) shows that even countries that showed more resilience in the aftermath of the crisis, such as the United Kingdom, Belgium, Denmark and the Netherlands, saw steep declines in public administration employment (see Graph 1.1.3.). Cuts in public sector wages have been widely implemented in countries like Ireland, Cyprus, Portugal (see Graph 1.1.4.).

Graph 1.1.3.: Changes in Public Sector Employment Following the Crisis



Source: Gama et al. (2015)

Graph 1.1.4.: Changes in Public Sector Wages Following the Crisis



Source: Eurostat

In this paper, we develop a DSGE model through which we can study the differential effects of quantity-based and price-based consolidation measures. In particular, we consider a New-Keynesian model of a two-block monetary union, with nominal rigidities in the form of monopolistic retailers facing price-stickiness. In order to build a complete model of the labour market, we incorporate both search and matching frictions, leading to involuntary unemployment, and an endogenous labour force participation decision, leading to voluntary unemployment. Finally, to study the effects of the public wage bill, we allow the government to hire public employees to produce a public good that is used by private firms.

Following Erceg and Linde (2013) and Pappa et al. (2015), fiscal policy responds to the deviation of the debt-to-GDP ratio from a target value, and fiscal consolidation occurs when this target is hit by a negative shock. We focus attention on two fiscal consolidation instruments on the part of the government: public wage cuts and public vacancy cuts. We consider each instrument separately, assuming that if one is active, the other remains fixed at its steady state value. We then repeat this experiment when the economy faces low inflation due to a liquidity trap. This setup allows us to compare, for a given consolidation volume, the effects of the alternative consolidation strategies in different environments.

There has been little work so far in explicitly modelling the interaction between the private and the public sector. The existing literature has largely focused on evaluating the impact of the public sector on the level or volatility of employment and wages (see e.g. Algan et al. (2002), Quadrini and Trigari 2007, Horner et al. 2007, and Gomes 2015b). Ardagna (2007) has shown using a DSGE model with a unionized labour market (but without unemployment) that, in response to a debt-financed increase in public-sector employment and wages, unions demand higher wages, which leads to a fall in private-sector employment and capital stock, and a contraction in the economy.

Michaillat (2014) makes an important contribution by finding that the "government multiplier", defined as the additional number of workers hired in the private sector when one public job is created, is positive and countercyclical, suggesting that the public sector tends to stabilize labour market fluctuations. Bradley et al. (2015) are the first to estimate (using British data) a model with equilibrium unemployment and a public sector. The authors also run simulations that attempt to mimic austerity measures implemented across Europe after the 2008 recession, namely a reduction in public sector hiring, an increase in public sector layoffs, and progressive and proportional cuts to the distribution of wages in the public sector. They find that all four policies increase hiring and turnover in the private sector, reduce public sector employment which is largely compensated by an increase in private sector employment, summing up to very moderate changes in aggregate unemployment; and finally, exert a very small impact on mean wages and in the aggregate economy. In an earlier contribution, Demekas and Kontolemis (2000) developed a simple two-sector model of the labour market with endogenous unemployment, but without explicit dynamics, showing that increases in government wages lead through worker flow dynamics to increases in private sector wages and, therefore, directly to higher unemployment. Increases in government employment do not have a significant impact on unemployment, and might even raise it. Using data for Greece, they found strong support for their theoretical predictions. On the empirical front, Cavallo (2005) found for the US that hours, output, and investment in the private sector decrease in response to an unanticipated increase in the government wage bill expenditure, in line with Finn (1998), but without distinguishing between public wage and employment policies.

In our model, in normal times, a fiscal consolidation through a cut in public wages is able to reduce the public debt-to-GDP ratio faster than public vacancy costs, although both have similar positive effects on private output through an increase in private-sector hirings. In the case of public wage cuts the increase in private-sector employment dominates the fall in public employment, leading to a fall in the unemployment rate, while in the case of public vacancy cuts the unemployment rate rises. Hence, public wage cuts are a preferable consolidation strategy to public vacancy cuts in normal times.

In a low inflation environment, induced by a negative demand shock, the fall in demand leads to a fall in private output, which, along with the rise in the real interest rate, causes government debt-to-GDP to rise. Hence a much larger cut in the public wage bill is required to bring debt to the desired level, meaning that the consolidation in this environment has large negative effects. The differences between the two instruments appear less pronounced in a low inflation environment; yet, again, public wage cuts lead to a reduction in the long-run unemployment rate, while public vacancy cuts induce a persistent rise in unemployment.

The remainder of the paper is organised follows. In Section 1.1.2., we provide the details of the model. Section 1.1.3. discusses the results of the different policy experiments and extensive sensitivity analysis. Section 1.1.4. concludes.

1.1.2. The Model

We consider a two-country DSGE model of a monetary union with search and matching frictions, endogenous labour force participation, and sticky prices in the short run. The two countries, labeled Home and Foreign, are of sizes n and $1 - n$, respectively. The following subsections describe the Home economy in more detail: the structure of the Foreign economy is analogous. All variables are in *per capita* terms. Where necessary, the conventional \star denotes foreign variables or parameters, and the subscripts h and f denotes goods produced in the Home and Foreign country and their respective prices.

There are four types of firms in each country: (i) a public firm that produces a good used in private production, (ii) private competitive firms that use labour, capital and the public good to produce a non-tradable intermediate good, (iii) monopolistic retailers that transform the intermediate good into a tradable good, and (iv) competitive final goods producers that use domestic and foreign produced retail goods to produce a final, non-tradable good which is used for investment and consumption. Price rigidities arise at the retail level, while labour market frictions occur in the intermediate goods sector. The representative household consists of private and public employees, unemployed, and labour force non-participants. The government collects taxes and uses revenues to finance the wages of public employees, the costs of opening new vacancies in the public sector and the provision of unemployment benefits.

1.1.2.1. Labour markets

We consider search and matching frictions in both the private and public labour markets. In each period, jobs in each sector, $j = p, g$, are destroyed at a constant fraction σ^j and a measure m^j of new matches are formed. The evolution of employment in each sector is thus given by:

$$n_{t+1}^j = (1 - \sigma^j)n_t^j + m_t^j \quad (1)$$

We assume that $\sigma^p > \sigma^g$ in order to capture the fact that, in general, public employment is more permanent than private employment.

The new matches are given by:

$$m_t^j = \rho^{jm}(v_t^j)^\alpha (u_t^j)^{1-\alpha}$$

where the matching efficiency, ρ^{jm} , can differ in the two sectors. From the matching functions specified above we can define, for each sector j , the probability of a jobseeker being hired, ψ^{hj}_t , and of a vacancy being filled, ψ^{fj}_t :

$$\psi_t^{hj} \equiv \frac{m_t^j}{u_t^j}$$

$$\psi_t^{fj} \equiv \frac{m_t^j}{v_t^j}$$

1.1.2.2. Households

The representative household consists of a continuum of infinitely lived agents. The members of the household derive utility from leisure, which corresponds to the fraction of members that are out of the labour force, l_t , and a consumption bundle, c_t . Following Neiss and Pappa (2005), we also allow for variable labour effort, x_t , which leads to separable disutility. The instantaneous utility function is thus given by:

$$U(c_t, l_t, x_t) = \frac{c_t^{1-\eta}}{1-\eta} + \Phi \frac{l_t^{1+\varphi}}{1+\varphi} - \Upsilon \frac{x_t^{1+\xi}}{1+\xi}$$

where η is the inverse of the intertemporal elasticity of substitution, $\Phi > 0$ is the relative preference for leisure, φ is the inverse of the Frisch elasticity of labour supply, and $Y > 0$ and ζ are the utility parameters for variable labour effort.

At any point in time, a fraction n_t^p (n_t^g) of the household members are private (public) employees. Campolmi and Gnocchi (2014) and Bruckner and Pappa (2012) have added a labour force participation choice in New Keynesian models of equilibrium unemployment. Following Ravn (2008), the participation choice is modelled as a trade-off between the cost of giving up leisure and the prospect of finding a job. In particular, the household chooses the fraction of the unemployed actively searching for a job, u_t , and the fraction which are out of the labour force and enjoying leisure, l_t , so that:

$$n_t^p + n_t^g + u_t + l_t = 1 \quad (2)$$

The household chooses the fraction of jobseekers searching in each sector: a share s_t of jobseekers look for a job in the public sector, while the remainder, $(1 - s_t)$, seek employment in the private sector. That is, $\underline{u}_t^g \equiv s_t u_t$ and $u_t^p \equiv (1 - s_t)u_t$.⁽²⁾

The household owns the private capital stock, which evolves according to:

$$k_{t+1}^p = \left[1 - \frac{\omega}{2} \left(\frac{i_t^p}{i_{t-1}^p} - 1 \right)^2 \right] i_t^p + (1 - \delta^p) k_t^p \quad (3)$$

where i_t^p is private investment, δ^p is a constant depreciation rate and ω dictates the size of investment adjustment costs.

The budget constraint, in real terms, is given by

$$\begin{aligned} (1 + \tau^c)c_t + i_t^p + b_{g,t+1} + e_t r_{f,t-1} b_{f,t} & \quad (4) \\ \leq [r_t^p - \tau^k(r_t^p - \delta^p)]k_t^p + r_{t-1}b_{g,t} + e_t b_{f,t+1} \\ & + (1 - \tau^n)(w_t^p n_t^p x_t + w_t^g n_t^g) + bu_t + \Pi_t^p + T_t \end{aligned}$$

where w_t^j are the real wages in the two sectors, r_t^p is the real return on capital, b denotes unemployment benefits, Π_t^p are the profits of the monopolistic retailers, discussed below, and τ_c , τ_k , τ_n , and T_t represent taxes on private consumption, private capital, labour income and lump-sum transfers, respectively. $b_{g,t}$ are government bonds which pay the real return r_{t-1} , whereas $b_{f,t}$ denote liabilities with the Foreign country. Although the nominal exchange rate is fixed, the interest rate on foreign assets, $r_{f,t}$, is still affected by consumer inflation differentials between the two countries, which are captured by the real exchange rate, e_t . In fact, we can define the nominal interest rate at Home, R_t , through Fisher equation

$$r_t = \frac{R_t}{\pi_{t+1}}$$

where π_t is the gross consumer inflation rate.

(2) For simplicity, we will abstract from variable labour effort in the public sector.

Thus the problem of the household is to choose $c_t, u_t, s_t, n_{t+1}^p, n_{t+1}^g, x_t, v_t^p, k_{t+1}^p, b_{g,t+1}, b_{f,t+1}$ to maximise lifetime utility subject to the budget constraint, (4), the law of motion of employment in each sector, (1), the law of motion of capital, (3), and the composition of the household, (2). The resulting first order conditions are provided in an online appendix.⁽³⁾ For use below, we define the marginal value of an additional private sector employee as:

$$\begin{aligned} V_{n_t^p}^H &= \lambda_{ct} w_t^p x_t (1 - \tau^n) - \Phi l_t^{-\varphi} + (1 - \sigma^p) \lambda_{n_t^p} \\ &= \lambda_{ct} w_t^p x_t (1 - \tau^n) - \Phi l_t^{-\varphi} + (1 - \sigma^p) \beta E_t V_{n_{t+1}^p}^H \end{aligned}$$

where λ_{ct} and $\lambda_{n_t^p}$ are the Lagrange multipliers on the budget constraint and the law of motion of private employment respectively.

1.1.2.3. Production

Intermediate goods firms

Intermediate goods are produced with a Cobb-Douglas technology:

$$y_t^p = (A_t n_t^p x_t)^{1-\varphi} (k_t^p)^\varphi (y_t^g)^\nu$$

where A_t is a labour augmenting productivity factor, k_t^p and n_t^p are private capital and labour inputs, x_t is the effort intensity of labour. Following Barro (1990) and Turnovsky (1999), we allow the public good, y_t^g , to enter the private production function, taken as exogenous by the firms. The parameter ν regulates how the public input affects private production: when ν is zero, the government good is unproductive.

Since current hires give future value to intermediate firms, the optimization problem is dynamic and hence firms maximize the discounted value of future profits. The number of workers currently employed, n_t^p , is taken as given and the employment decision concerns the number of vacancies posted in the current period, v_t^p , so as to employ the desired number of workers next period, n_{t+1}^p .⁽⁴⁾ Firms also decide the amount of the private capital, k_t^p , to be rented from the household at rate r_t^p . The problem of an intermediate firm with n_t^p currently employed workers consists of choosing k_t^p and v_t^p to maximize:

$$\begin{aligned} Q^p(n_t^p) &= \max_{k_t^p, v_t^p} \left\{ p_{x,t} (A_t n_t^p x_t)^{1-\varphi} (k_t^p)^\varphi (y_t^g)^\nu - w_t^p n_t^p x_t - r_t^p k_t^p - \kappa v_t^p \right. \\ &\quad \left. + E_t \Lambda_{t,t+1} Q^p(n_{t+1}^p) \right\} \end{aligned}$$

where $p_{x,t}$ is the relative price of intermediate goods, κ is a utility cost associated with posting a new vacancy, and $\Lambda_{t,t+1} = \beta \lambda_{ct+1} / \lambda_{ct}$ is the discount factor. The maximization takes place subject to the private employment transition equation, where the firm takes the probability of the vacancy being filled as given:

$$n_{t+1}^p = (1 - \sigma^j) n_t^p + \psi_t^p v_t^p$$

⁽³⁾ The online appendix can be found at sites.google.com/site/ranasajedi

⁽⁴⁾ Firms adjust employment by varying the number of workers (extensive margin) rather than the number of hours per worker. According to Hansen (1985), most of the employment fluctuations arise from movements in this margin.

The first-order conditions are:

$$p_{x,t} \phi \frac{y_t^p}{k_t^p} = r_t^p$$

$$\frac{\kappa}{\psi_t^{fp}} = E_t \Lambda_{t,t+1} \left[p_{x,t+1} (1 - \phi) \frac{y_{t+1}^p}{n_{t+1}^p} - w_{t+1}^p x_{t+1} + (1 - \sigma^p) \frac{\kappa}{\psi_{t+1}^{fp}} \right]$$

These two first order conditions require that the value of the marginal product of private capital should equal the real rental rate and the marginal cost of opening a vacancy should equal the expected marginal benefit. The latter includes the marginal productivity of labour minus the wage plus the continuation value, knowing that with probability σ^p the match can be destroyed.

The expected value of the marginal job for the intermediate firm, $V_{n_t^p}^F$ is:

$$V_{n_t^p}^F \equiv \frac{\partial Q^p(n_t^p)}{\partial n_t^p} = p_{x,t} (1 - \phi) \frac{y_t^p}{n_t^p} - w_t^p x_t + (1 - \sigma^p) \frac{\kappa}{\psi_t^{fp}}$$

Retailers

There is a continuum of monopolistically competitive retailers indexed by i on the unit interval. Retailers buy intermediate goods and differentiate them with a technology that transforms one unit of intermediate goods into one unit of retail goods, and thus the relative price of intermediate goods, $p_{x,t}$, coincides with the real marginal cost faced by the retailers. Let y_{it} be the quantity of output sold by retailer i . The final consumption good can be expressed as:

$$y_t = \left[\int_0^1 (y_{it})^{\frac{\epsilon-1}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}$$

where $\epsilon > 1$ is the constant elasticity of demand for each variety of retail goods. The final good is sold at a price $P_{h,t} = \left[\int_0^1 (P_{iht})^{\epsilon-1} di \right]^{\frac{1}{\epsilon-1}}$. The demand for each intermediate good depends on its relative price and on aggregate demand

$$y_{i,t} = \left(\frac{P_{i,h,t}}{P_{it}} \right)^{-\epsilon} y_t^r \quad (5)$$

Following Calvo (1983), we assume that in any given period each retailer can reset its price with a fixed probability $(1 - \chi)$. Firms that are able to reset their price choose $P_{i,h,t}^*$ so as to maximize expected real profits given by

$$\Pi_t(i) = \max_{P_{i,h,t}} E_t \sum_{s=0}^{\infty} (\beta\chi)^s \Lambda_{t,t+s} \left(\left[\frac{P_{i,h,t}}{P_{t+s}} - p_{x,t+s} \right] y_{i,t+s} \right)$$

subject to the demand schedule (5), in each period. Since all firms are ex-ante identical, $P_{i,h,t}^* = P_{h,t}^*$ for all i . The resulting expression for $P_{h,t}^*$ is

$$\frac{P_{h,t}^*}{P_{h,t}} = \frac{\epsilon}{\epsilon - 1} \frac{N_t}{D_t}$$

where

$$N_t = p_{x,t} y_t^r + \beta \chi \Lambda_{t,t+1} (\pi_{h,t+1})^\epsilon N_{t+1}$$

$$D_t = p_{h,t} y_t^r + \beta \chi \Lambda_{t,t+1} (\pi_{h,t+1})^{\epsilon-1} D_{t+1}$$

$p_{h,t}$ is the real domestic price of y_t^r and $\pi_{h,t}$ denotes producer inflation. Under the assumption of Calvo pricing, the price index, in nominal terms, is given by

$$P_{h,t} = \chi (P_{h,t-1})^{\epsilon-1} + (1 - \chi) (P_{h,t}^*)^{1-\epsilon}$$

Retail goods are sold domestically and abroad. In aggregate,

$$y_t^r = y_{h,t} + y_{h,t}^*$$

where $y_{h,t}$ is the share of retail goods sold domestically and $y_{h,t}^*$ the quantity sold abroad, and we have assumed the law of one price holds

$$p_{h,t} = e_t p_{h,t}^*$$

Final Goods Producer

Finally, in each country perfectly competitive firms produce a non-tradable final good by aggregating domestic and foreign aggregate retail goods using technology

$$y_t = \left[\varpi^{\frac{1}{\gamma}} (y_{h,t})^{\frac{\gamma-1}{\gamma}} + (1 - \varpi)^{\frac{1}{\gamma}} (\tau y_{f,t})^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

where $\tau \equiv (1 - n)/n$ normalizes the amount of imported goods at Home to *per capita* terms. The home-bias parameter ϖ denotes the fraction of goods produced at home that are used in the production of the final good. The elasticity of substitution between home-produced and imported goods is given by γ . Final good producers maximize profits $y_t - p_{h,t} y_{h,t} - p_{f,t} \tau y_{f,t}$ each period. Solving for the optimal demand functions gives

$$y_{h,t} = \varpi (p_{h,t})^{-\gamma} y_t$$

$$y_{f,t} = (1 - \varpi) (p_{f,t})^{-\gamma} \frac{n}{1 - n} y_t$$

The consumer price index, P_t , is defined by substituting out $y_{h,t}$ and $y_{f,t}$ in the CES above by the respective demand curves, which yields

$$P_t = \varpi (P_{h,t})^{1-\gamma} + (1 - \varpi) (P_{f,t})^{1-\gamma}$$

1.1.2.4. Government

The government sector produces the public good using public capital and labour:

$$y_t^g = (A_t n_t^g)^{1-\mu} (k_t^g)^\mu$$

where we assume that productivity shocks are not sector specific and μ is the share of public capital. For simplicity, we assume the public capital stock is fixed at a steady state value, \bar{k}^g .

Government expenditure consists of public wages, public vacancy costs and unemployment benefits, while revenues come from the consumption, capital income, labour income and lump-sum taxes. The government deficit is therefore defined by:

$$DF_t = w_t^g n_t^g + \kappa v_t^g + \varpi u_t - TR_t$$

where

$$TR_t \equiv \tau^n (w_t^p n_t^p x_t + w_t^g n_t^g) + \tau^k (r_t^p - \delta^p) k_t^p + T + \tau^c c_t$$

denotes tax revenues.

The government budget constraint is given by:

$$b_{g,t} + DF_t = b_{g,t+1} / r_t$$

We assume that tax rates are constant and fixed at their steady state levels, and we do not consider them as active instruments for fiscal consolidation. Thus the government has two potential fiscal instruments, v_g and w_g . We consider each instrument separately, assuming that if one is active, the other remains fixed at its steady state value. For $\Psi \in \{v_g, w_g\}$, we assume fiscal rules of the form, following Erceg and Linde (2013) and Pappa et al. (2015):

$$\Psi_t = \Psi^{(1-\beta_{\Psi_0})} \Psi_{t-1}^{\beta_{\Psi_0}} \left[\left(\frac{b_t}{b_t^*} \right)^{\beta_{\Psi_1}} \left(\frac{\Delta b_{t+1}}{\Delta b_{t+1}^*} \right)^{\beta_{\Psi_2}} \right]^{(1-\beta_{\Psi_0})} \quad (6)$$

where $b_t = B_t / y_t$ is the debt-to-GDP ratio and b_t^* is the target debt-to-GDP ratio, given by the AR(2) process:

$$\log b_t^* - \log b_{t-1}^* = \mu^b + \rho_1 (\log b_{t-1}^* - \log b_{t-2}^*) - \rho_2 \log b_{t-1}^* - \varepsilon_t^b$$

where ε_t^b is a white noise shock representing a fiscal consolidation.⁽⁵⁾

1.1.2.5. Closing the model

Monetary policy

There is a single independent monetary authority that sets the nominal interest rate to target zero net inflation, subject to the ZLB:

$$R_t^* = \max\{1, \rho R_{t-1}^* + (1 - \rho) \rho_\pi \tilde{\pi}_t\}$$

where $\tilde{\pi}_t$ is the sum of national consumer inflations, weighted by population sizes, $n\pi_t + (1 - n)\pi_t^*$. For the Home, consumer inflation is defined as:

⁽⁵⁾ Notice that public wage cuts reduce the wage bill in the public sector in the same period, while public vacancy cuts reduce it with a lag from next period.

$$\frac{\pi_{h,t}}{\pi_t} = \frac{p_{h,t}}{p_{h,t-1}}$$

With fixed nominal exchange rates, the real exchange rate equals the ratio of consumer prices:

$$\frac{e_t}{e_{t-1}} = \frac{\pi_t^*}{\pi_t}$$

Finally, and to render the model stationary, we introduce a risk premium charged to Home households depending on the relative size of net-foreign-liabilities to total output:

$$r_{f,t} = r_t^* \Xi \exp\left(\Gamma \bar{e}_t \frac{b_{f,t+1}}{rgdp_t}\right)$$

Resource constraint

The non-tradable domestic final good is sold for consumption and for investment:

$$y_t = c_t + i_t^p$$

and, following, Gomes (2015a), total output is defined as private output plus the wage bill:

$$rgdp_t = p_{x,t} y_t^p + w_t^g n_t^g$$

Aggregating the budget constraint of households using the market clearing conditions, the budget constraint of the government, and aggregate profits $V_t = \int_i \Pi_R(i) di$, we obtain the law of motion for net foreign assets, which is given by:

$$e_t (r_{f,t-1} b_{f,t} - b_{f,t+1}) = nx_t$$

and where nx_t are net exports defined as:

$$nx_t = p_{h,t} y_{h,t}^* - p_{f,t} \bar{y}_{f,t}$$

Wage bargaining

Private sector wages are determined by ex post (after matching) Nash bargaining. Workers and firms split rents and the part of the surplus they receive depends on their bargaining power. If we denote by $\vartheta \in (0, 1)$ the firms' bargaining power, the Nash bargaining problem is to maximize the weighted sum of log surpluses:

$$\max_{w_t^p} \left\{ (1 - \vartheta) \ln V_{n_t^p}^H + \vartheta \ln V_{n_t^p}^F \right\}$$

where $V_{n_t^p}^H$ and $V_{n_t^p}^F$ have been defined above. The optimization problem leads to the following solution for w_t^p :

$$w_t^p x_t = (1 - \vartheta) p_{x,t} (1 - \phi) \frac{y_t^p}{n_t^p} + \frac{\vartheta}{(1 - \tau^n) \lambda_{c,t}} \Phi l_t^{-\varphi}$$

Hence, the equilibrium wage is a weighted average of the marginal product of employment and the disutility from labour, with the weights given by the firm and household's bargaining power respectively.⁽⁶⁾

1.1.2.6. Model Solution and Calibration

We solve the model by linearising the equilibrium conditions around a non-stochastic steady state in which all prices are flexible, the price of the private good is normalized to unity, and inflation is zero. When considering the ZLB, which is a non-linear constraint, we use the Occbin toolkit provided by Guerrieri and Iacoviello (2015).

Table 1.1.1. shows some of the key parameters and steady-state values targeted in our calibration. Full details of the calibration strategy are provided in the online appendix.

Table 1.1.1.: Calibration of Parameters and Steady-State Values

Parameter/Variable	Description	Value
<i>Preferences:</i>		
β	Household discount factor	0.99
η	Intertemporal Elasticity of Substitution	1
φ	Inverse Frisch Elasticity of Labour	4
<i>Labour Market:</i>		
$1-l$	Labour force participation	65%
$u / (1-l)$	Unemployment rate	10%
n_g / n	Share of public employment	18%
κ / w	Vacancy costs as a share of wages	4.5%
<i>Production:</i>		
v	Productivity of public good	0.05
φ, μ	Share of capital in production	0.36
k_g / k_p	Public-private capital ratio	0.31
χ	Price-stickiness	0.75
<i>Policy Parameters:</i>		
ρ_π	Taylor-rule inflation targeting parameter	2.5
ρ_1, ρ_2	Debt-target law of motion	0.85, 0.0001
b	Steady-state debt-to-GDP ratios	50%

Source: Authors' calculations.

1.1.3. Results

We consider a shock which drives the debt-to-GDP ratio target around 2pp below its steady state after 10 quarters. We simulate the response to this shock under the two alternative policy instruments, v^g and w^g . We then consider the same shock in a low inflation environment. Following the literature, this environment is induced by assuming a positive shock to the household's discount rate, β , which causes inflation to fall, driving the nominal interest rate to its lower bound.⁽⁷⁾

(6) Full derivation is provided in the online appendix.

(7) We assume that the shock decays with auto-regressive parameter 0.5.

To further investigate the results, we also show the role of the different mechanisms of the model. Firstly, with respect to the assumptions about monetary and fiscal policy, we consider the role of the consolidation shock, the speed of adjustment during consolidation and the strength of the monetary policy response. Finally, we carry out sensitivity analysis with respect to some of the parameters in the model, looking in particular at the productivity of the public good, the size of investment adjustment costs and the elasticity of labour supply.

1.1.3.1. Consolidation in Normal Times

In this section we analyse the role of consolidation in normal times, when the economy is not subject to deflationary shocks.

Quantity-based Measures: Public Vacancy Cuts

We start by analyzing the effects of fiscal consolidation when vacancy cuts are assumed to be the fiscal policy instrument for achieving the lower debt target. Results from this exercise are presented in Graph 1.1.5. We see that the cut in public vacancies causes a fall in public employment, and hence both the public wage bill and public output fall with a lag. Eventually, some of the jobseekers leaving the public sector move sluggishly towards the private sector, causing a rise in private employment. At the same time, the reduction in expenditure on the public wage bill creates a positive wealth effect for the household, causing a rise in private consumption. This, plus the fall in private wages, crowds out private investment and leads to a reduction in private capital. Yet, private output increases due to the availability of cheaper labour, despite the fall in public output, which also serves as an input in private production. The unemployment rate increases persistently due to the fall in public employment and the increase in the labour force participation rate. Finally, despite the boost to private output, real GDP falls after the consolidation as a result of the fall in the public wage bill.

Price-based Measures: Public Wage Cuts

Graph 1.1.6. depicts the case in which fiscal consolidation is achieved through cuts in the public wage. The public wage cut causes a significant fall in the fraction of jobseekers in the public sector. As before, this causes a movement of jobseekers towards the private sector, and boosts private employment. In the case of wage cuts, the subsequent decrease of the private wage reduces marginal costs of firms in the private sector and this increases the demand for labour and boosts private employment. Due to the fall in public wages and the increase in demand in the private sector, unemployed shift their supply of labour towards the private sector. Hence, public employment is also decreasing, as in the case of vacancy cuts, but for different reasons. Differently from before, the adjustment is less sluggish, as labour force participation also rises, and private wages are reduced soon after the public wage cut. As a result, private vacancies increase on impact and this leads to increases in both private employment and capital. Despite the fall in income, we see that again the consolidation causes a positive wealth effect for the household, raising consumption and investment. Hence, despite the fall in public output, we again see a rise in private output. It is also important to note that the consolidation is much more successful in the case of public wage cuts, with the debt-to-GDP ratio falling to its new target after 12 quarters. Total GDP falls also in the case of public wage cuts but less persistently relative to the case of vacancy cuts.

Hence, in line with Bradley et al. (2015), we find that in normal times cuts in the public wage bill reduce public sector employment and increase hiring in the private sector. However, our results indicate that the effects on aggregate unemployment are different for the two instruments considered: in the case of public wage cuts (price-based measure) the increase in private-sector employment prevails and we observe a fall in the unemployment rate, while in the case of public

vacancy cuts (quantity-based measure) the fall in public employment is such that leads to an increase in the unemployment rate.

1.1.3.2. Consolidation in a Low Inflation Environment

In this section we analyse how our conclusions about fiscal consolidation through public wage bill cuts change when the monetary union operates in a low inflation environment.

Quantity-based Measures: Public Vacancy Cuts

Graph 1.1.7. shows the impulse response functions when public vacancies are the active consolidation instrument in a low inflation environment. For comparability purposes, the blue solid line depicts the baseline simulations in response to the fiscal consolidation shock only. First, notice that the effects of the consolidation shock alone are very small compared to the effects of the discount rate shock. The red line depicts the responses in a low inflation environment induced by the shock to the household's discount rate, when imposing the ZLB constraint. Here we see that the nominal and the real interest rates fall sharply. Yet, the gross nominal rate reaches its lower bound and cannot fall more than 1% in deviations from its steady state value since in that case it hits the ZLB. With the negative demand shock, we observe a fall in private consumption and an increase in private investment compared to the baseline case. The latter leads to increases in private capital. However, despite the rise in capital, the demand contraction leads to a fall in private labour demand and, hence, private employment. The negative wealth effect is so strong that agents increase further their participation, leading to a considerable increase in unemployment. The simultaneous contraction in the private and the public sector leads to a rise in public debt despite the consolidation. This means that public vacancies need to fall by much more than the baseline case, reducing public employment and output by more. This further reinforces the fall in private output and makes consolidation difficult to achieve.

In contrast, in the absence of a ZLB constraint, depicted by the green dashed lines, the economic effects of the shock would be much more moderate. In such a case, since the nominal rate can sufficiently offset the fall in inflation, the real rate falls more and mitigates the contraction in the private sector, actually expanding private investment. In this scenario, in fact, the debt-to-GDP target is reached almost immediately due to the significant fall in the interest rate and after the first two periods the consolidation is reversed.⁽⁸⁾

Price-based Measures: Public Wage Cuts

Graph 1.1.8. plots impulse responses for the case of public wage cuts. Again, the blue continuous lines depict the baseline responses presented in Sub-section 1.1.3.2., red lines show responses when the ZLB constraint is binding and the economy is hit by a discount rate shock and the green lines show the unrestricted responses in the presence of the deflationary shock. Responses look very similar with the responses of the vacancy cut case: When the interest rate is not bounded by the zero constraint, its fall allows the government to achieve consolidation very fast and actually after two periods consolidation is reversed, leading to increases in public wages. This shifts labour supply towards the public sector, reducing employment in the private sector and contracting private output

⁽⁸⁾ In experiments we do not present here for economy of space we show that without the consolidation shock, this economy would suffer very little from the discount shock and if anything the consolidation intensifies the effects of the shock by crowding out private employment since it is reversed.

despite the surge in private investment induced by the lower value of the real rate. On the other hand, public output expands so much that total real GDP increases after the first 4 quarters.⁽⁹⁾

Moving to the more interesting case of the equilibrium in which the ZLB constraint is imposed, we see that the fall in the nominal interest rate is not enough to bring inflation back to equilibrium. The fall in the real rate expands investment more than in the baseline case, but consumption contracts significantly due to the demand shock. Firms can hire workers for a lower wage as in the benchmark case, but demand is contracted. Private vacancies do not increase that much on impact, leading to a fall in private employment and tax revenues, making the consolidation much more difficult to achieve in this environment.

To sum up, the fall in private output induced by the negative effects of the deflationary shock makes it more difficult for the government to consolidate debt and attenuates the positive effects of the consolidation in normal times. In this case, public wage cuts lead to a rise in unemployment for several periods, and have a similar negative effect on private output, hence they are no longer obviously preferable to vacancy cuts.

1.1.3.3. Sensitivity Analysis I: Fiscal and Monetary Policy

The Role of the Consolidation Shock

To understand better how consolidation affects the economy at the ZLB in this subsection we analyse the dynamics of the economy at the ZLB when consolidation is imposed (continuous lines) and when it is not (crossed lines) in Graphs 1.1.9. and 1.1.10. for vacancy cuts and wage cuts, respectively.

For the case of vacancy cuts, the presence or not of fiscal consolidation when a deflationary shock hits the economy makes very little difference. The deflationary shock increases debt and according to the debt rule specified in Equation (6), the public vacancies react even without the consolidation shock. Yet, apart from the obvious effects the consolidation has on public vacancies and the public wage bill and its immediate effect on public employment and output, the presence or not of a consolidation shock changes very little the dynamics of the private sector. Private employment seems to react a bit faster in the presence of a consolidation shock, but this differentiated response does not seem to affect significantly the dynamics of the private-sector economy.

The picture is, however, different when we look at public wage cuts in Graph 1.1.10. The consolidation in this case does help the faster recovery of the private sector by leading to stronger positive reactions of investment and private employment and increases in private vacancies. As a result, private output falls less under this scenario, making the recovery of the economy following the combined shocks faster.

The Speed of Adjustment during Consolidation

In Graphs 1.1.11. and 1.1.12. we examine how our conclusions would change if we considered a faster speed of adjustment for the fiscal consolidations in the case of vacancy cuts and wage cuts, respectively. Notice that because of difficulties in satisfying the stability criteria in the model we cannot freely change the parameters of debt adjustments for the two instruments (especially for vacancy cuts). Nonetheless, faster debt adjustment seems to imply that for both fiscal instruments the recovery of the private sector is somewhat faster. Since the debt consolidation shocks can undo the

⁽⁹⁾ Again, in experiments we do not present here for economy of space we demonstrate that the economy can recover even faster from the deflationary shock in the absence of the consolidation shock.

negative effects of the deflationary shock in the economy, requiring the instruments to adjust faster implies a stronger reaction of private employment, and hence smaller detrimental effects of the deflationary shock on private output. This of course comes at the cost of a higher public output and wage bill adjustment that results in a more negative response of real GDP.

The Strength of Monetary Policy

In Graphs 1.1.13. and 1.1.14. we examine the sensitivity of our results to the conduct of monetary policy at the union level. The circled lines depict responses of the economy when we assume a more lax monetary policy ($\rho_\pi=1,1$), while continuous lines depict responses in our baseline model. Responses for the two instruments differ significantly in this case. For price-based measures (public wage cuts) implementing debt consolidation when the ZLB constraint is binding in such a monetary policy environment implies that the economy will suffer from deflation and lower demand for a longer period. As a result, the consolidation has to be more pronounced, leading to significant falls in both private output and total GDP. On the other hand, in the case of quantity-based measures (vacancy cuts) deflation does not persist and as a result the differences between the case of stricter or more lax monetary policy are minimal. This is a crucial difference between the two consolidation instruments: wage cuts prolong the deflationary periods, while vacancy cuts as a quantity-based measure have little effects on inflation and their efficacy is independent of the stance of monetary policy.

Independent Monetary Policy

Finally, in Graphs 1.1.15. and 1.1.16. we compare the responses of the economy to a fiscal consolidation when the ZLB binds after a discount factor shock in the case of independent monetary policy (dashed lines), using a closed economy setup, and common monetary policy, using the previous monetary union setup (continues lines). Confirming the results of Erceg and Linde (2013) about spending cuts, a fiscal consolidation in a monetary union is much more detrimental relative to the case of independent monetary policy in a closed economy. This is evident from the responses of private output, real GDP and the unemployment rate both for public vacancy cuts and public wage cuts. These effects are mainly driven by the fact that inflation falls by more in the case of a monetary union and, as a result, the real interest rate falls and private investment increases by much less than in the case of a closed economy. Interestingly, when we compare the closed and open economy versions of our baseline model (without the discount factor shock), we can see in Graphs 1.1.17. and 1.1.18. that the effects of public vacancy cuts are more adverse, at least for five quarters, with independent monetary policy (closed economy).

1.1.3.4. Sensitivity Analysis II: Deep Parameters

Our results might be sensitive not only to the policy specification we adopt for the fiscal and monetary authority, but also to some assumptions about deep parameters in the model. In this section we examine some of them that we find are crucial for our analysis.

The Productivity of Public Output

The results we present are, of course, very sensitive to the assumed value for the productivity of the public good (v), as this is crucial in determining the effects of cuts in public wages or vacancies even in the baseline model when the ZLB does not bind. Despite the positive effects of the consolidation on private employment and capital, we have seen that both instruments lead to a fall in public output, and this leads to a direct negative effect in the private production function. The balance of these effects, and hence the effect of the consolidation on private output, depends on the productivity of the public good.

Given the importance of the parameter ν , it is only natural to ask how the productivity of the public output affects our conclusions about the effects of fiscal consolidation in the ZLB. Graphs 1.1.19. and 1.1.20. depict the responses of the baseline model with continuous lines, while circled lines represent the model economy responses when we assume a higher productivity of the public good in private production (we set $\nu = 0.15$ in this experiment). As it is clear from the results, making the public sector more productive implies a need for stronger fiscal consolidation after the discount factor shock, and a larger and more persistent fall in private output.

Investment Adjustment Costs

Investment adjustment costs are crucial determinants of the reaction of private capital to the consolidation shock, in particular in the presence of the demand shock. As we saw, the negative demand shock, by increasing the desire to save, increases private investment, which boosts private output and aids the consolidation effort. This is clearly indicated in Graphs 1.1.21. and 1.1.22. where we plot the responses of the economy when we increase the adjustment cost parameter from 0.5 to 3. With higher adjustment costs, investment and hence private capital do not rise as much, private output falls more, and the debt-to-GDP rises more.

Endogenous Labour Force Participation

The assumption of labour force participation could also affect our results since, as we have seen in the baseline analysis, agents adjust their participation decision when they feel the possibility of finding a job increases or when they suffer from a negative wealth effect. In turn, the change in participation affects labour supply and thus the equilibrium wage and production levels. In Graphs 1.1.23. and 1.1.24. we compare the responses of the model economy we shut the participation margin (circled lines) with the baseline responses (continuous lines) for vacancy and wage cuts, respectively.

When agents are not allowed to adjust their participation, private vacancies react less to the shock relative to the case of endogenous participation and, as a result, private employment reacts more negatively to the shock, reducing the reaction of private output and making it more difficult for the fiscal authorities to achieve the debt target.

1.1.4. Conclusions

In this paper, we have set up a DSGE model of a monetary union with search and matching frictions, nominal rigidities, and public employment. This rich model allows us to study non-trivial reallocation of agents in and out of the labour force, and between the public and private sector. In the baseline case, a fiscal consolidation through a cut in public wages is able to reduce the public debt-to-GDP ratio faster than public vacancy costs, although both have similar effects on private output and lead to a reduction in public employment and an increase in private-sector hirings. However, in the case of public wage cuts the increase in private-sector employment prevails, leading to a fall in the unemployment rate, while in the case of public vacancy cuts the fall in public employment is such that raises the unemployment rate. Hence, public wage cuts are a preferable consolidation strategy to public vacancy cuts in normal times.

In a low inflation environment a much larger cut in the public wage bill is required to bring the debt-to-GDP ratio to the desired level. The rise in the real interest rate when the ZLB constraint is binding leads to a rise in public debt and, as a result, makes consolidation more costly. The fall in demand creates a drag on the private sector, meaning that the consolidation in this environment has large negative effects. These negative effects are mitigated when monetary policy is conducted independently (in a closed economy setup). The differences between the two instruments appear less

pronounced in a low inflation environment; yet public wage cuts lead to a reduction in the long-run unemployment rate, while public vacancy cuts induce a persistent rise in unemployment.

As our sensitivity analysis showed, our model and parameter assumptions are important for determining the results. Given our model structure we could not extend our sensitivity analysis to all possible assumptions we have adopted. We know, for example, that the reallocation of workers from the public to the private sector is key for our results, as is the assumption of flexible wages. In future versions of this paper we plan to extend our sensitivity analysis to these and other primitives of our model.

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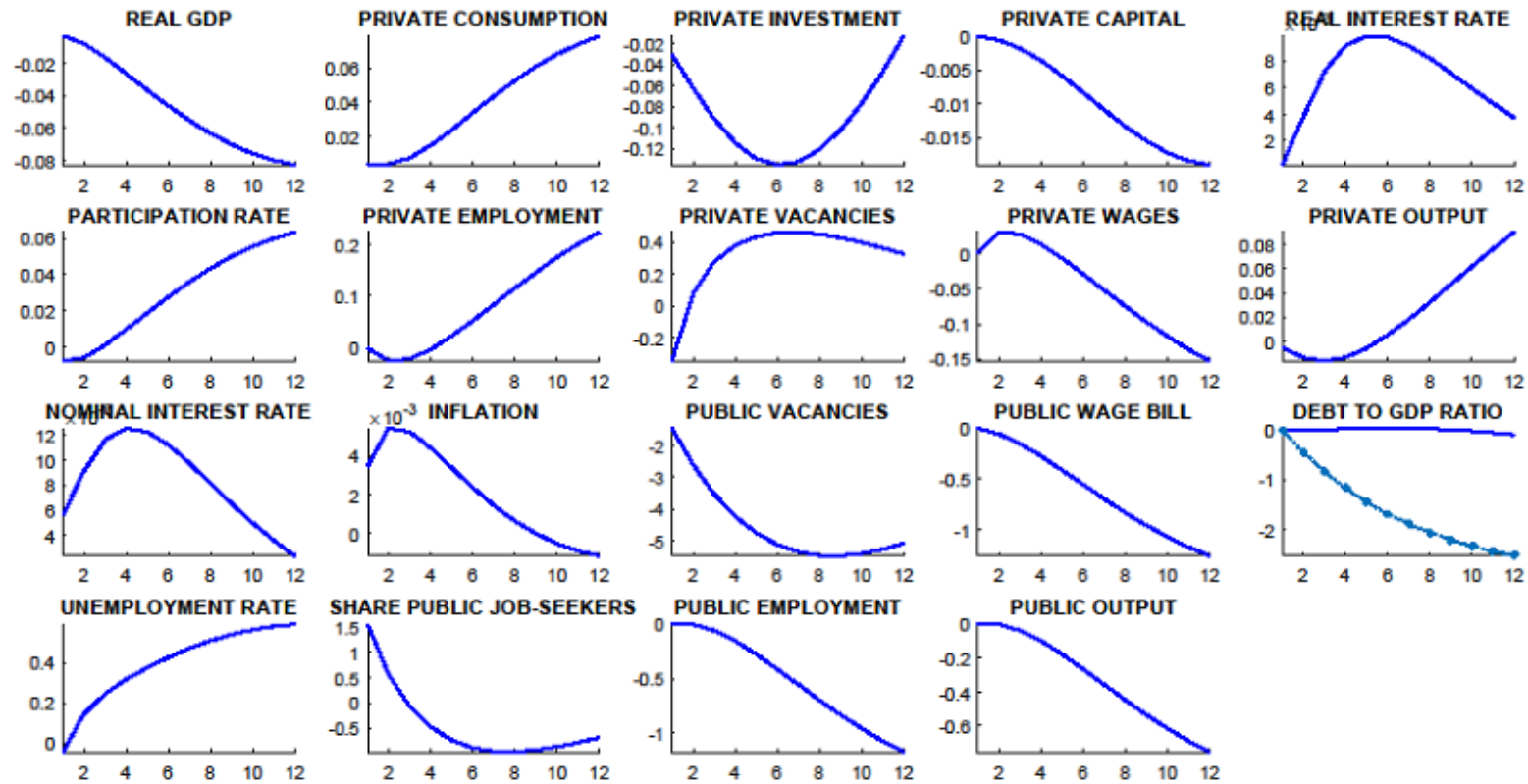
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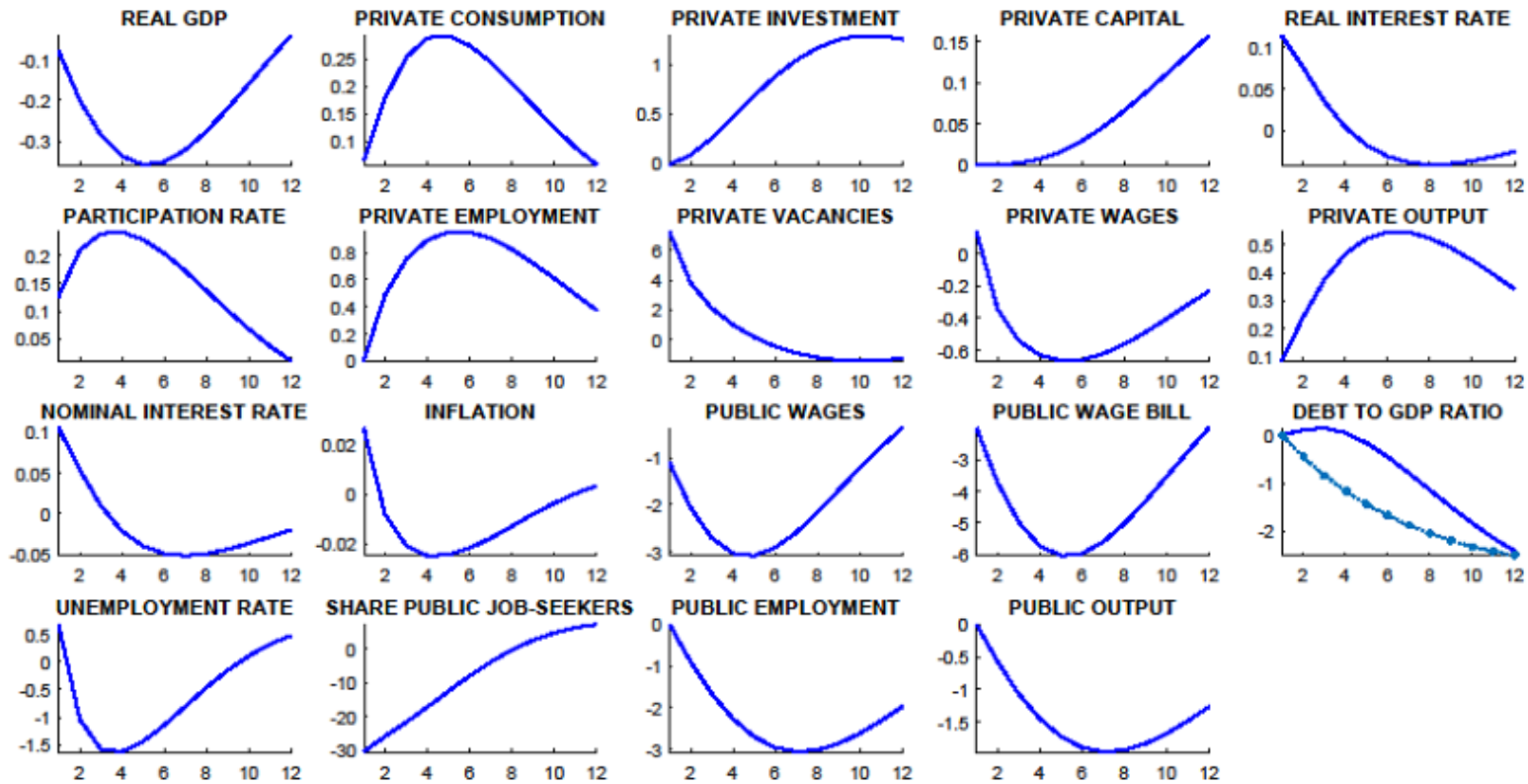
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ANNEX

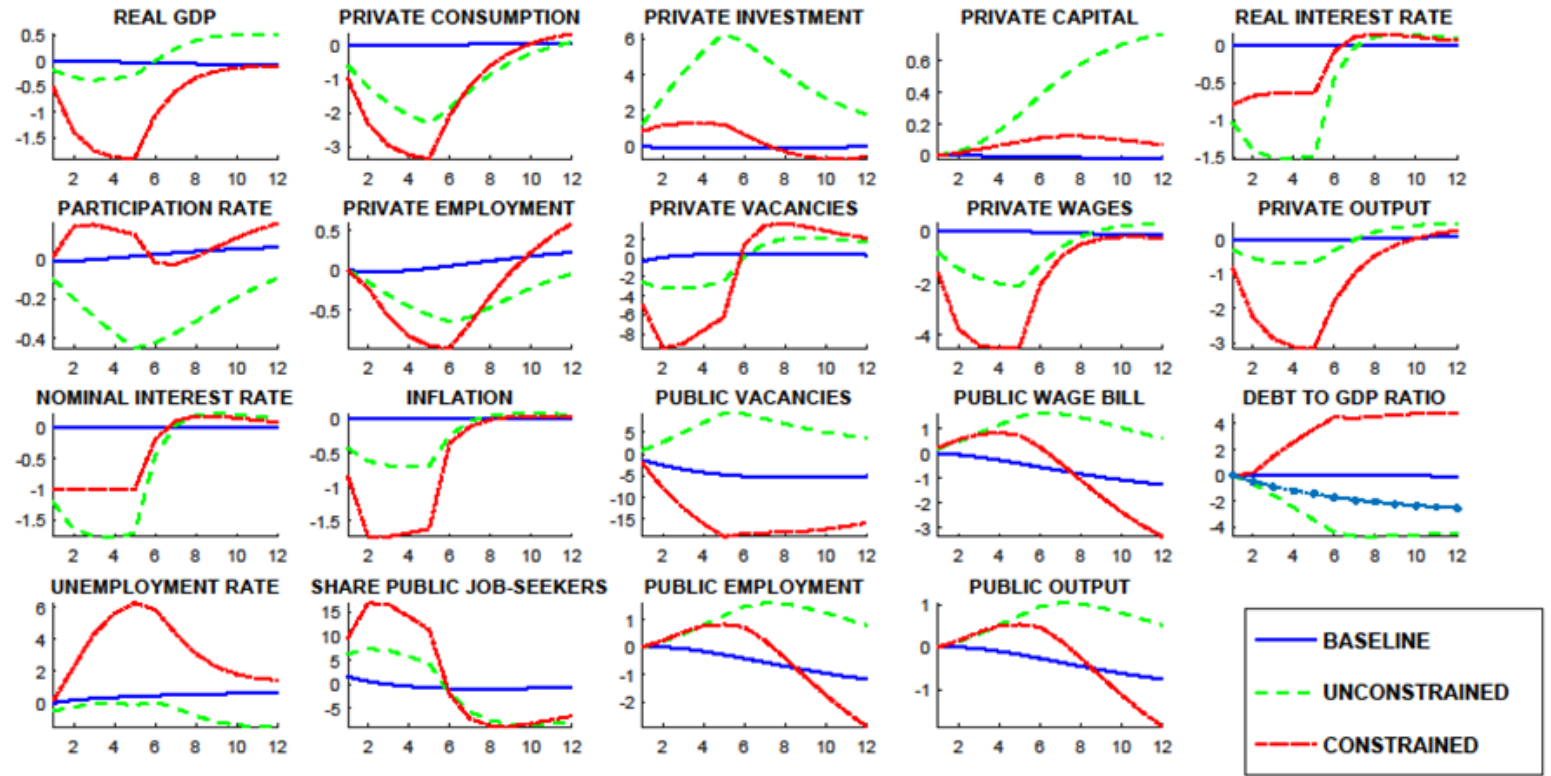
Graph 1.1.5.: Fiscal Consolidation with Public Vacancy Cuts



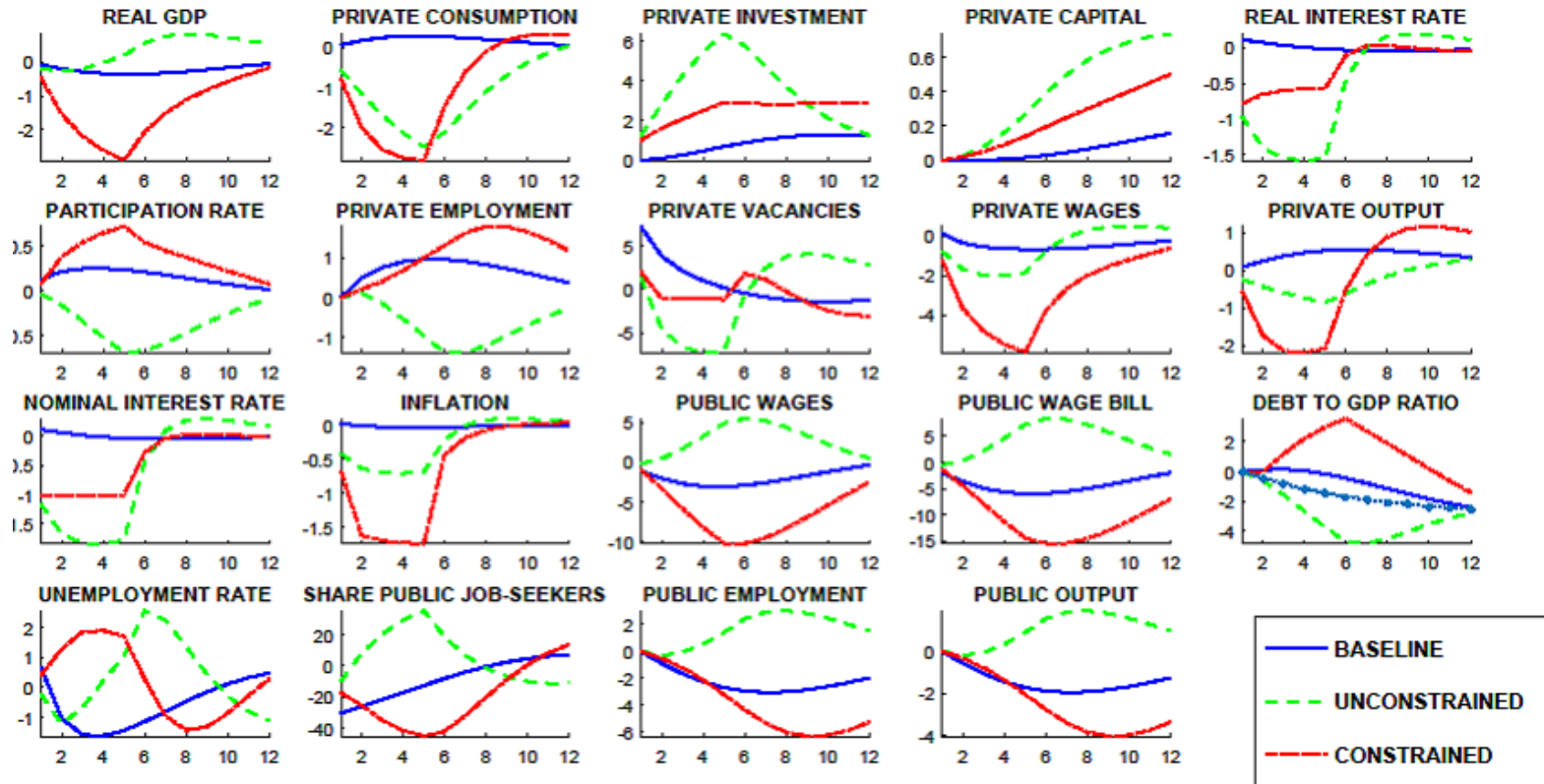
Graph 1.1.6.: Fiscal Consolidation with Public Wage Cuts



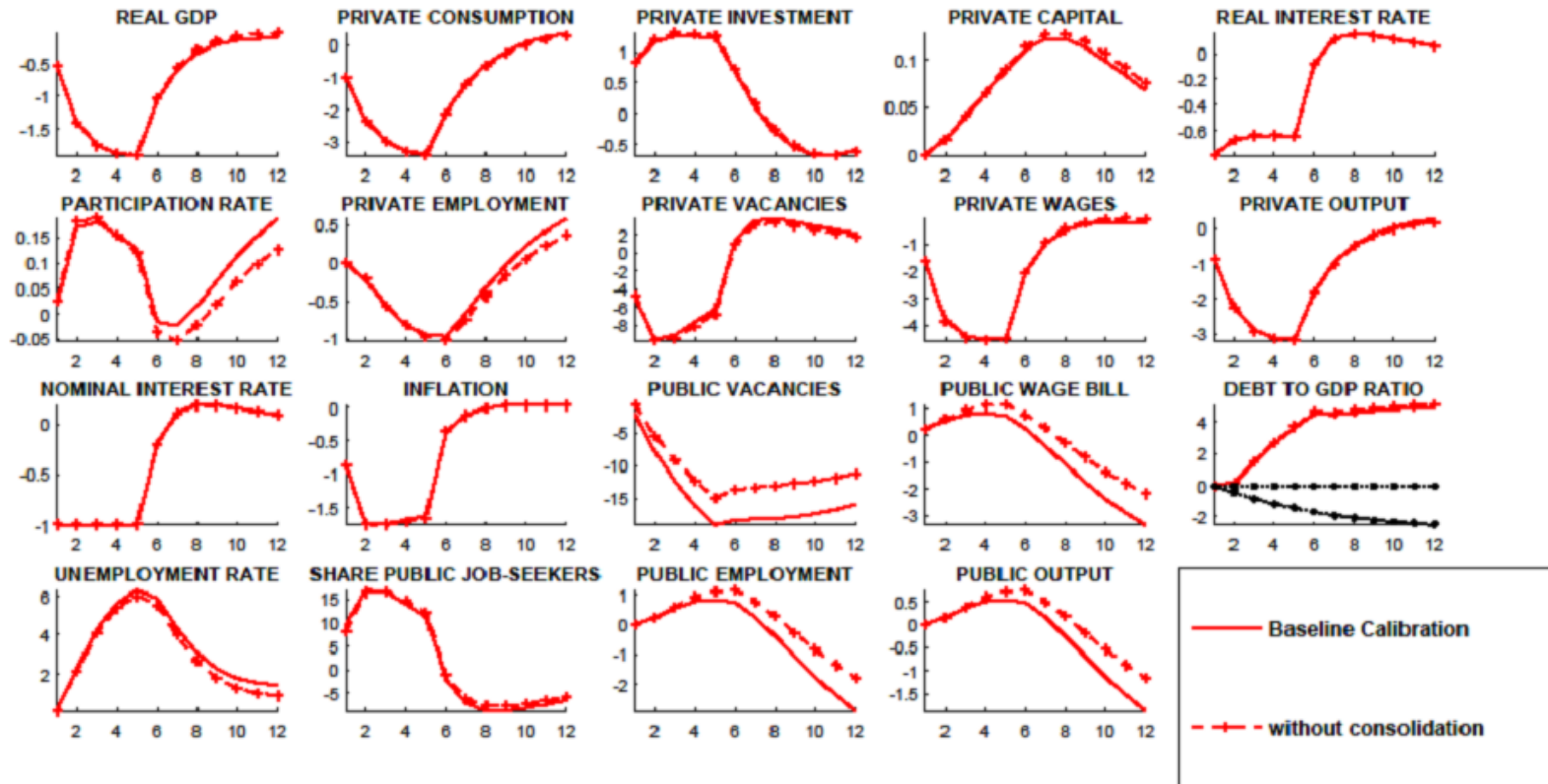
Graph 1.1.7.: Fiscal Consolidation in a Low Inflation Environment: Public Vacancy Cuts



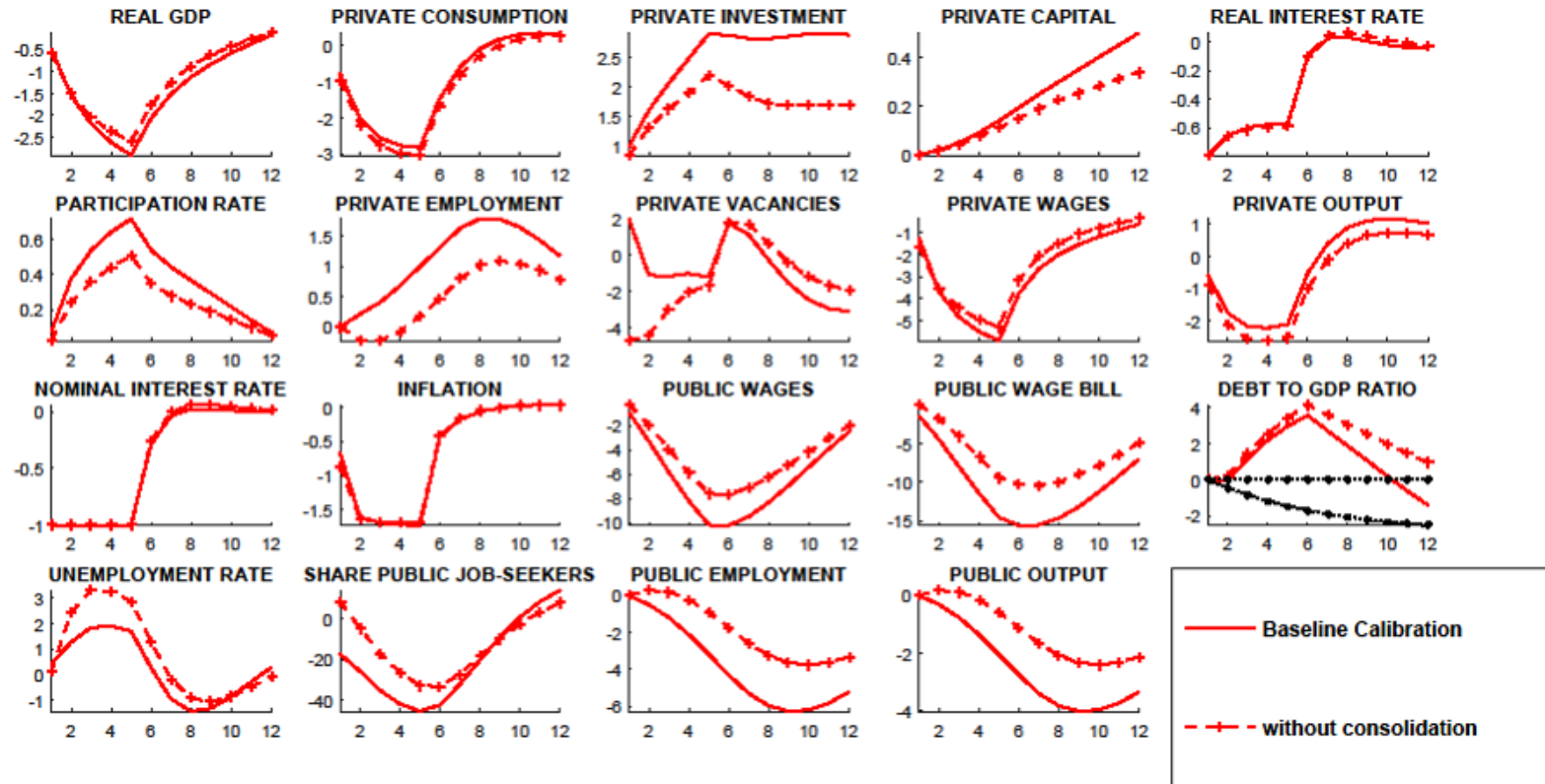
Graph 1.1.8.: Fiscal Consolidation in a Low Inflation Environment: Public Wage Cuts



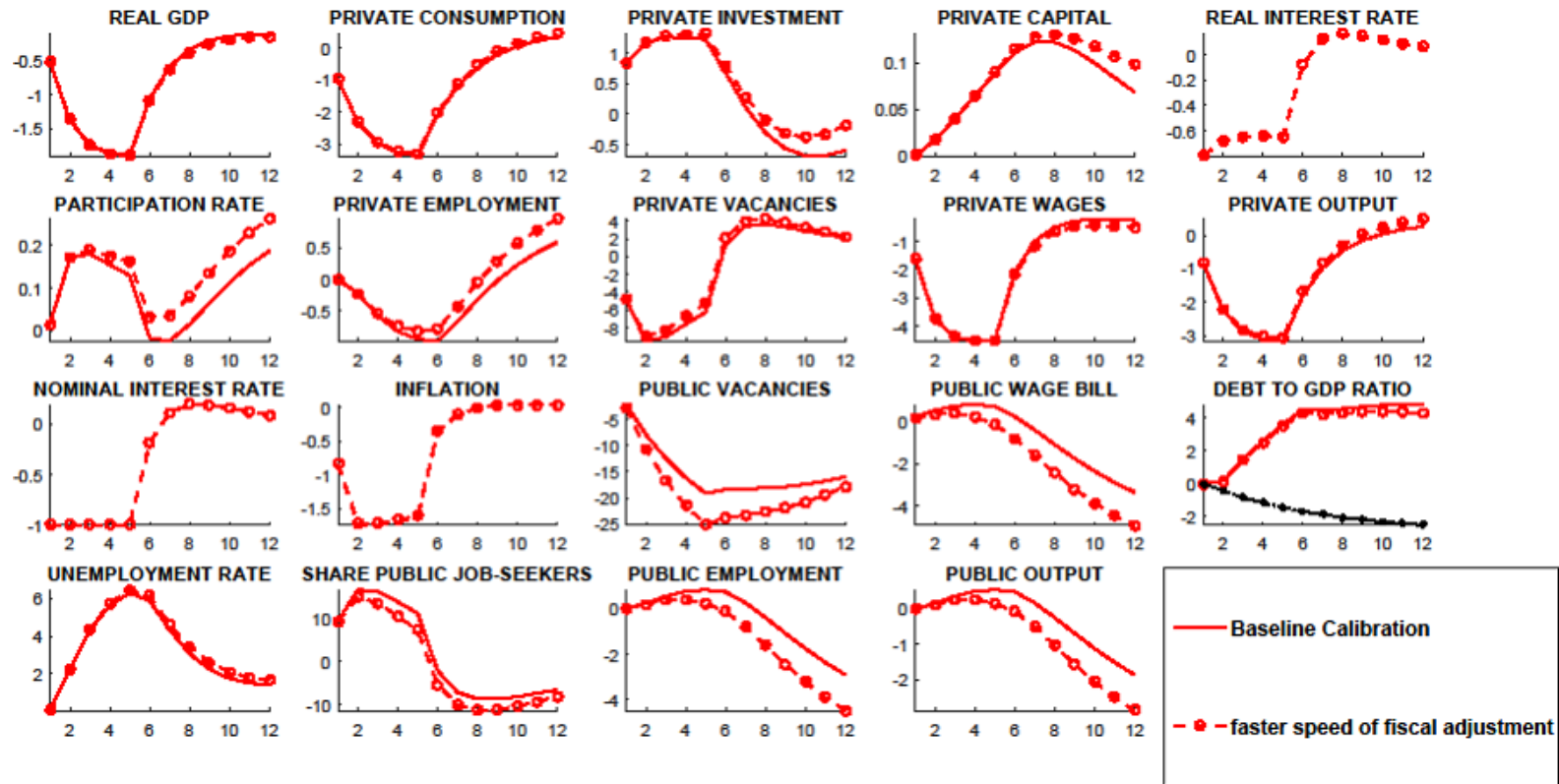
Graph 1.1.9.: Public Vacancy Cuts in a Low Inflation Environment: the Role of Consolidation



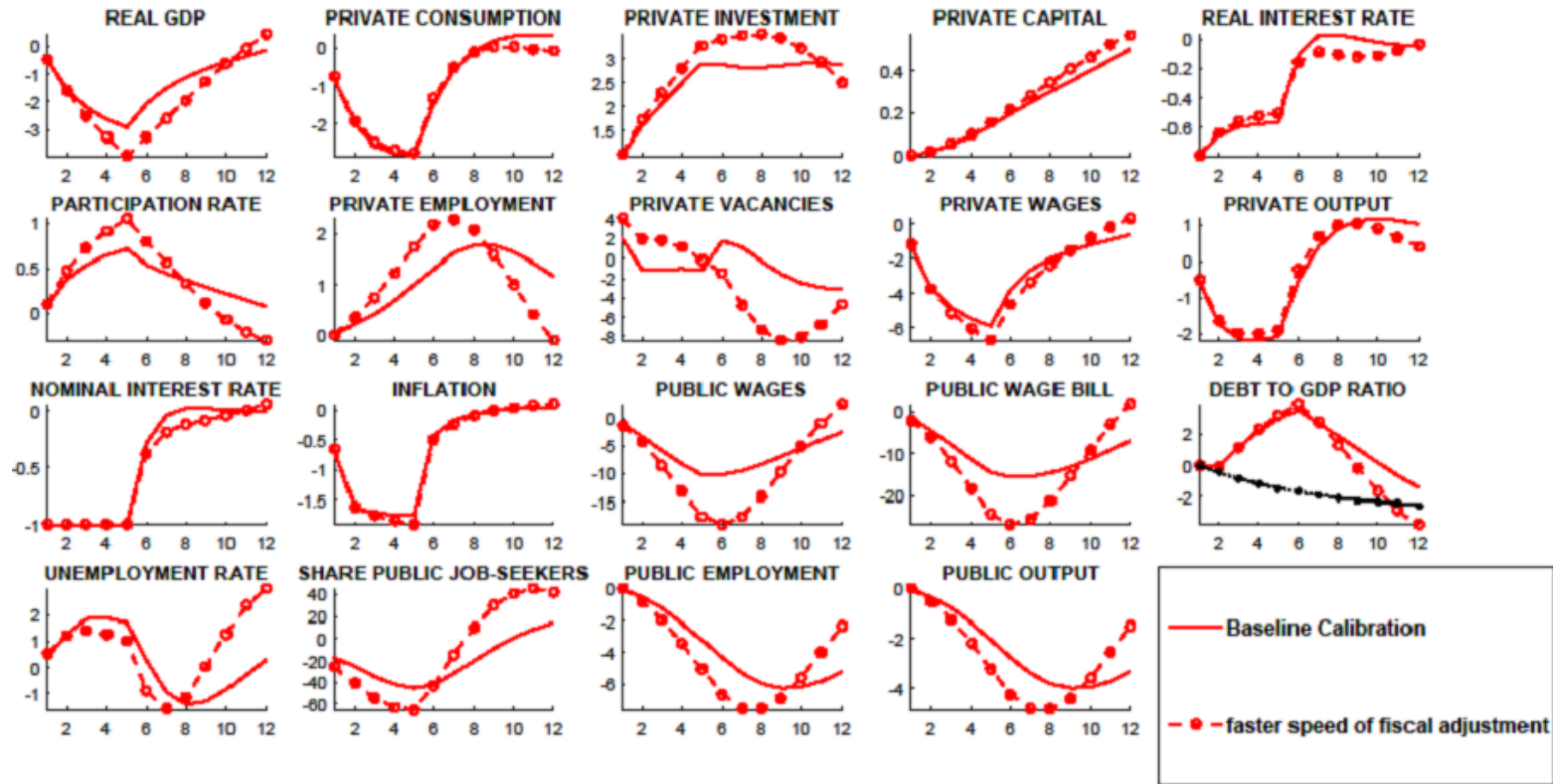
Graph 1.1.10.: Public Wage Cuts in a low Inflation Environment: the Role of Consolidation



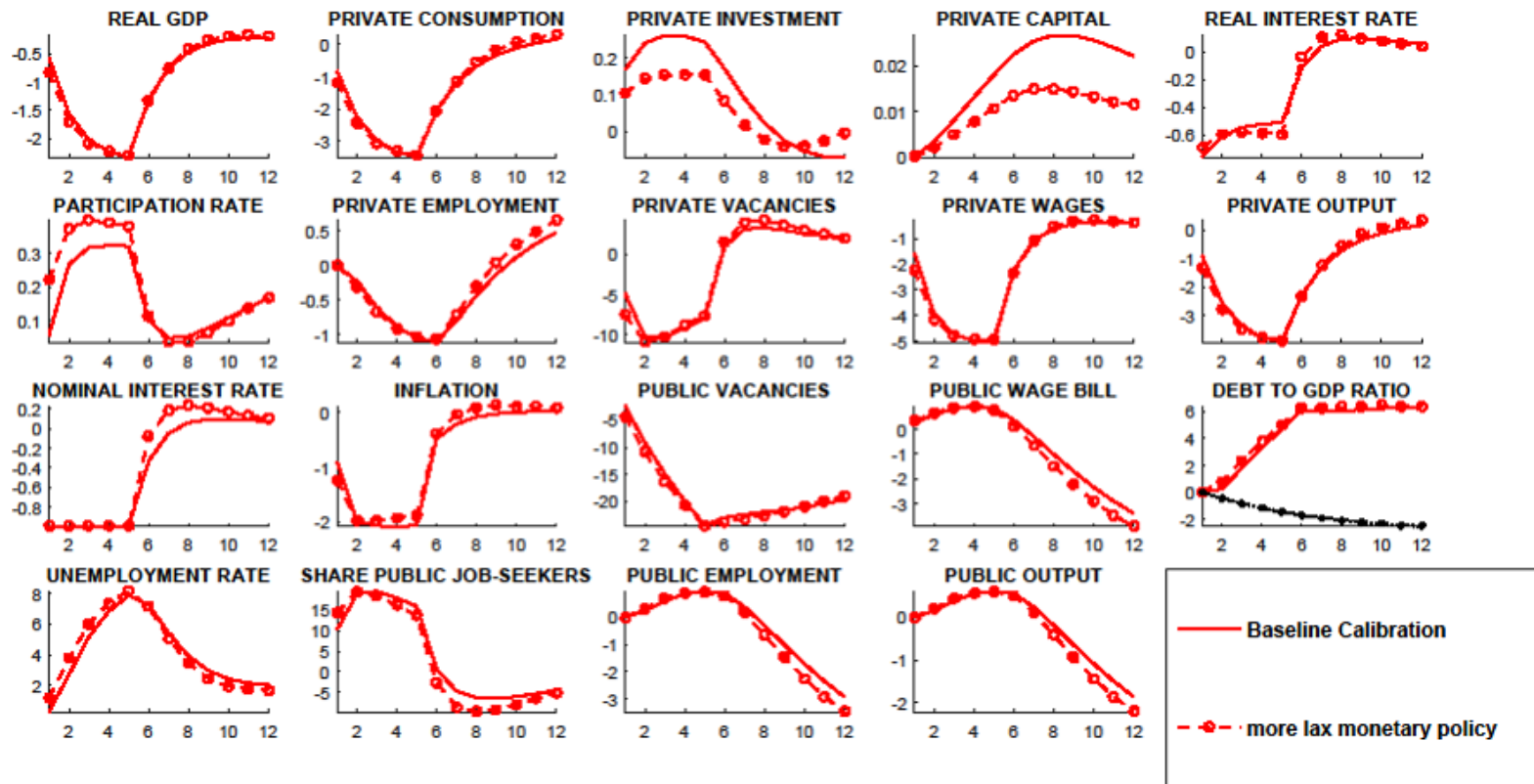
Graph 1.1.11.: Public Vacancy Cuts in a Low Inflation Environment: the Speed of Consolidation



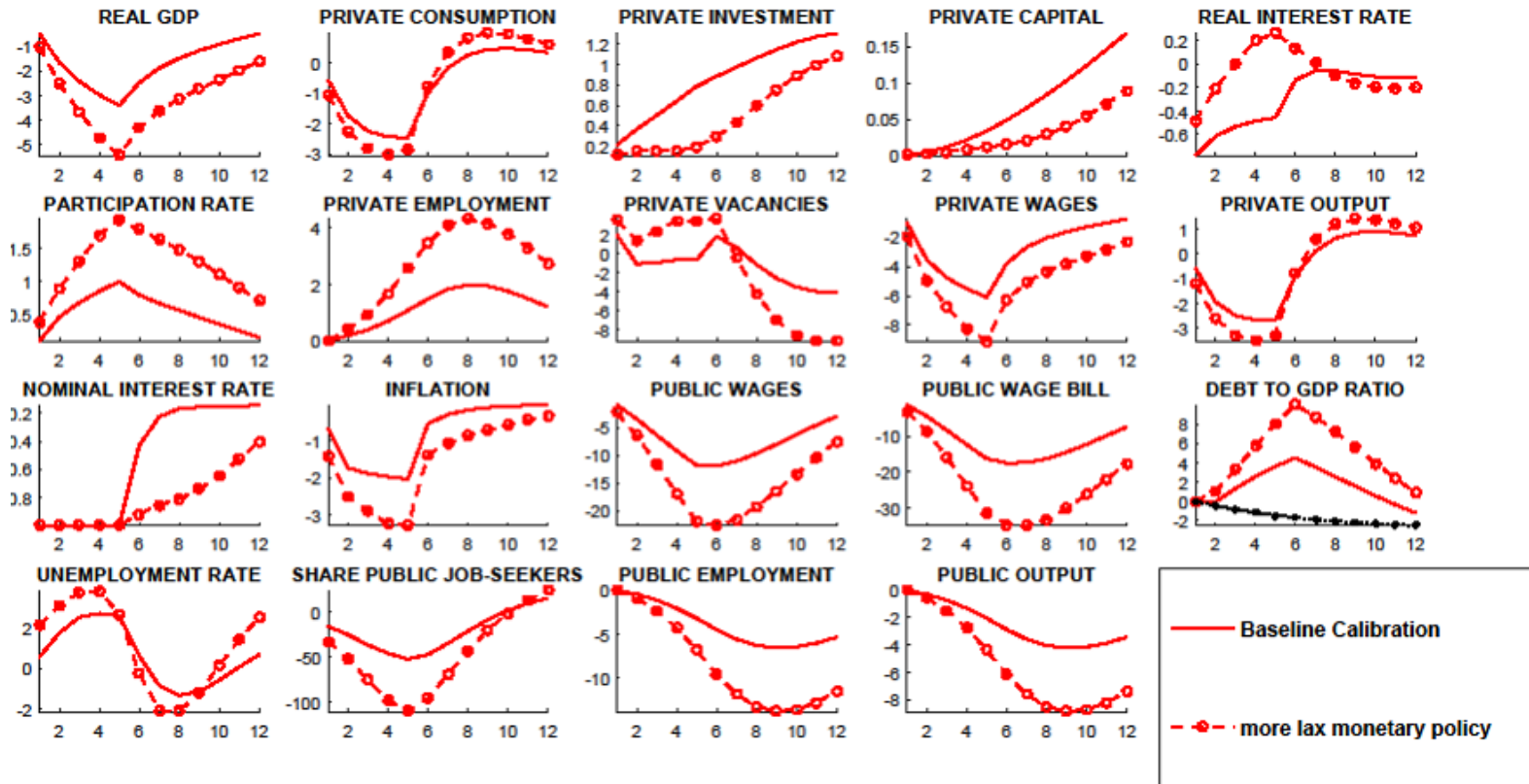
Graph 1.1.12.: Public Wage Cuts in a Low Inflation Environment: the Speed of Consolidation



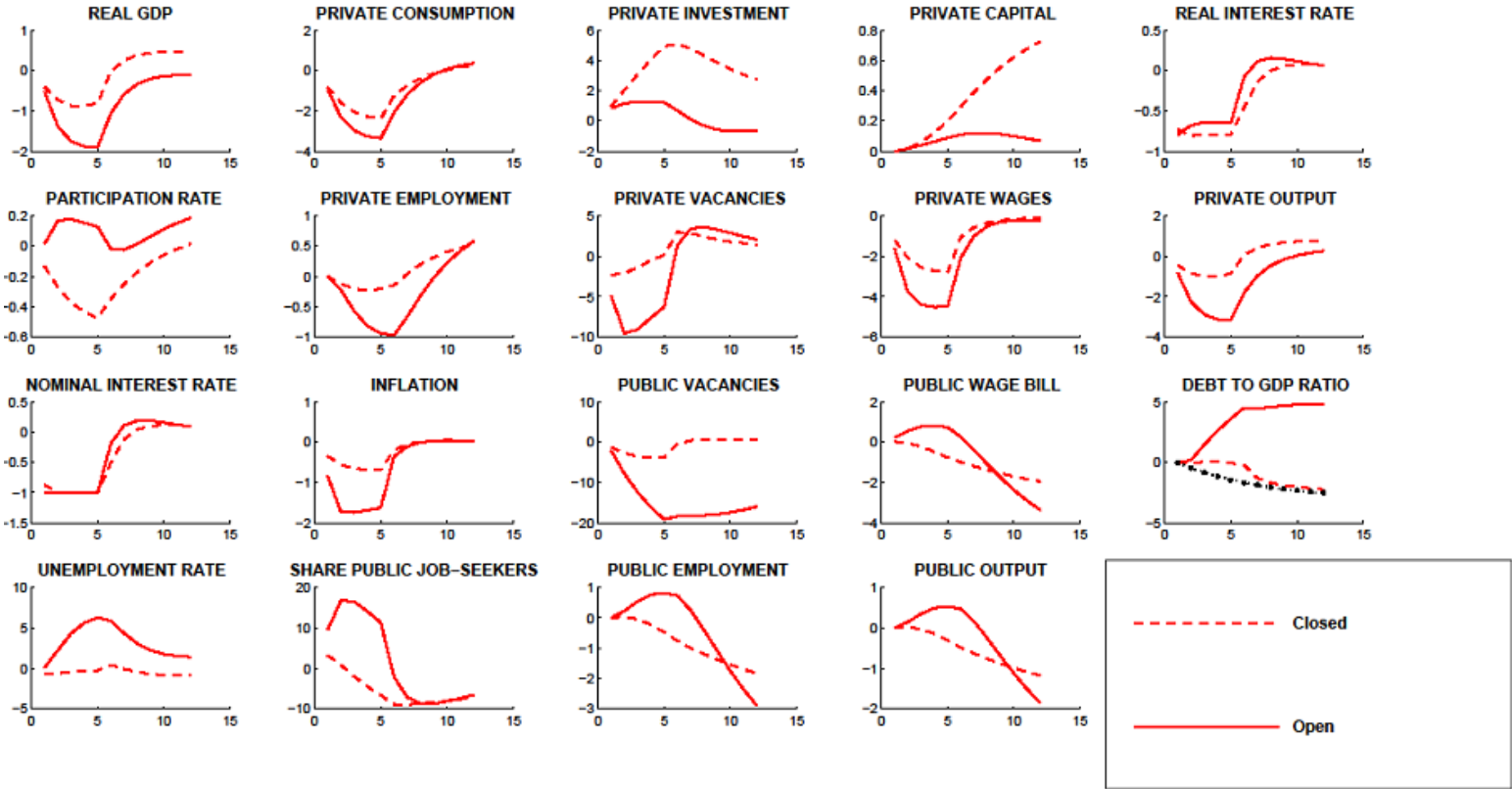
Graph 1.1.13.: Public Vacancy Cuts in a Low Inflation Environment: the Role of Monetary Policy Strength



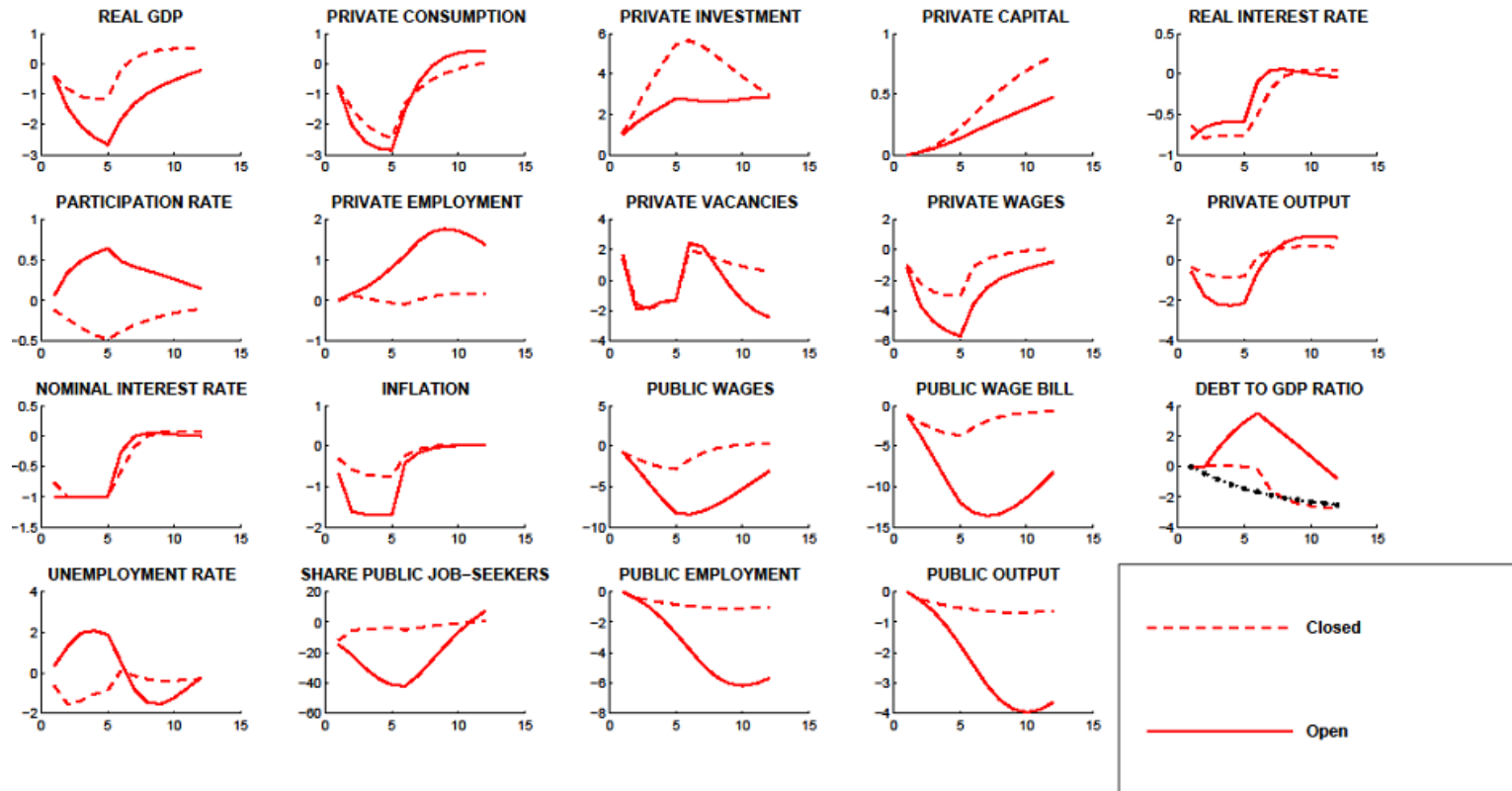
Graph 1.1.14.: Public Wage Cuts in a Low Inflation Environment: the Role of Monetary Policy Strength



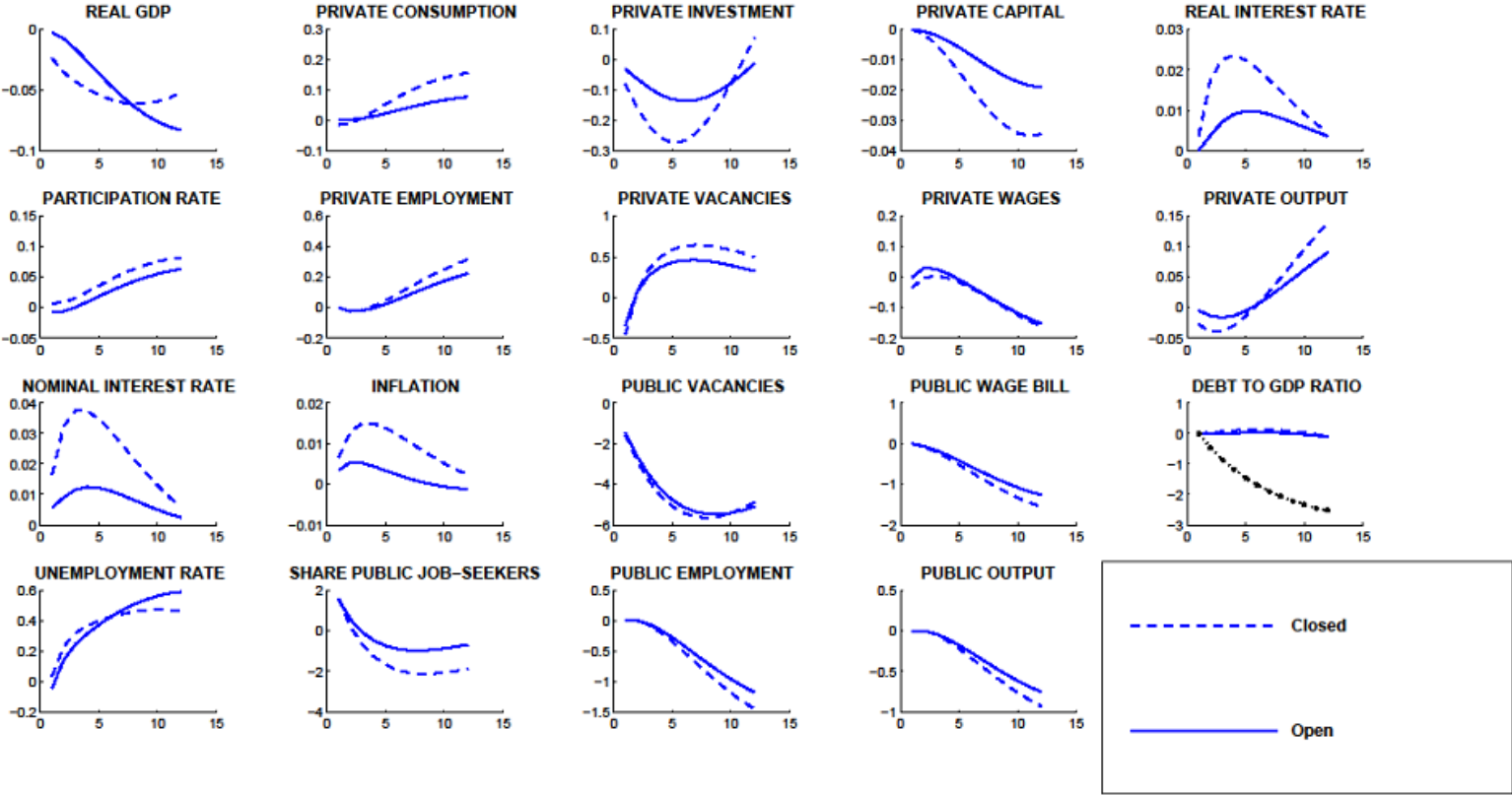
Graph 1.1.15.: Public Vacancy Cuts in a Low Inflation Environment: Closed versus Open Economy



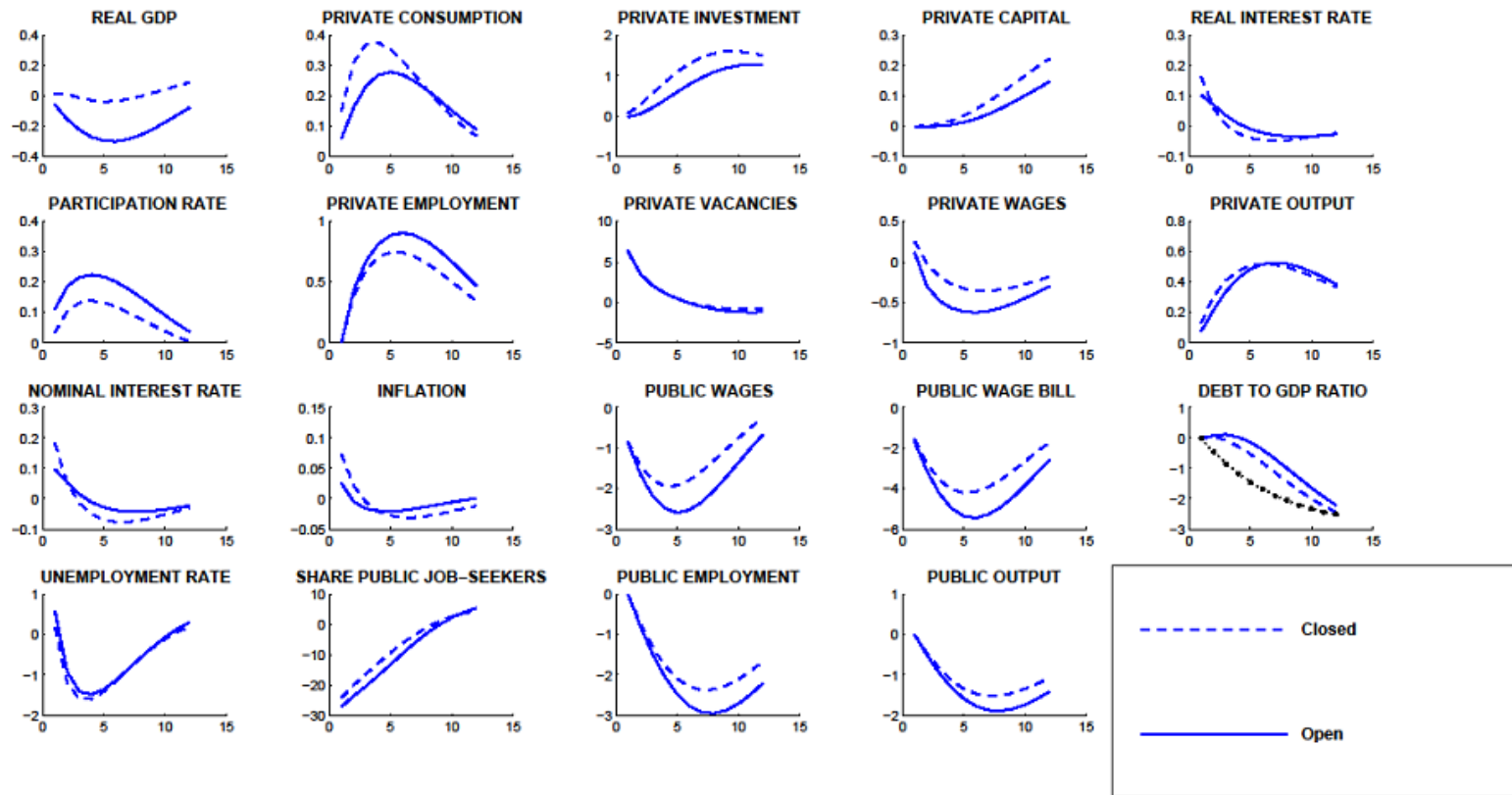
Graph 1.1.16.: Public Wage Cuts in a Low Inflation Environment: Closed versus Open Economy



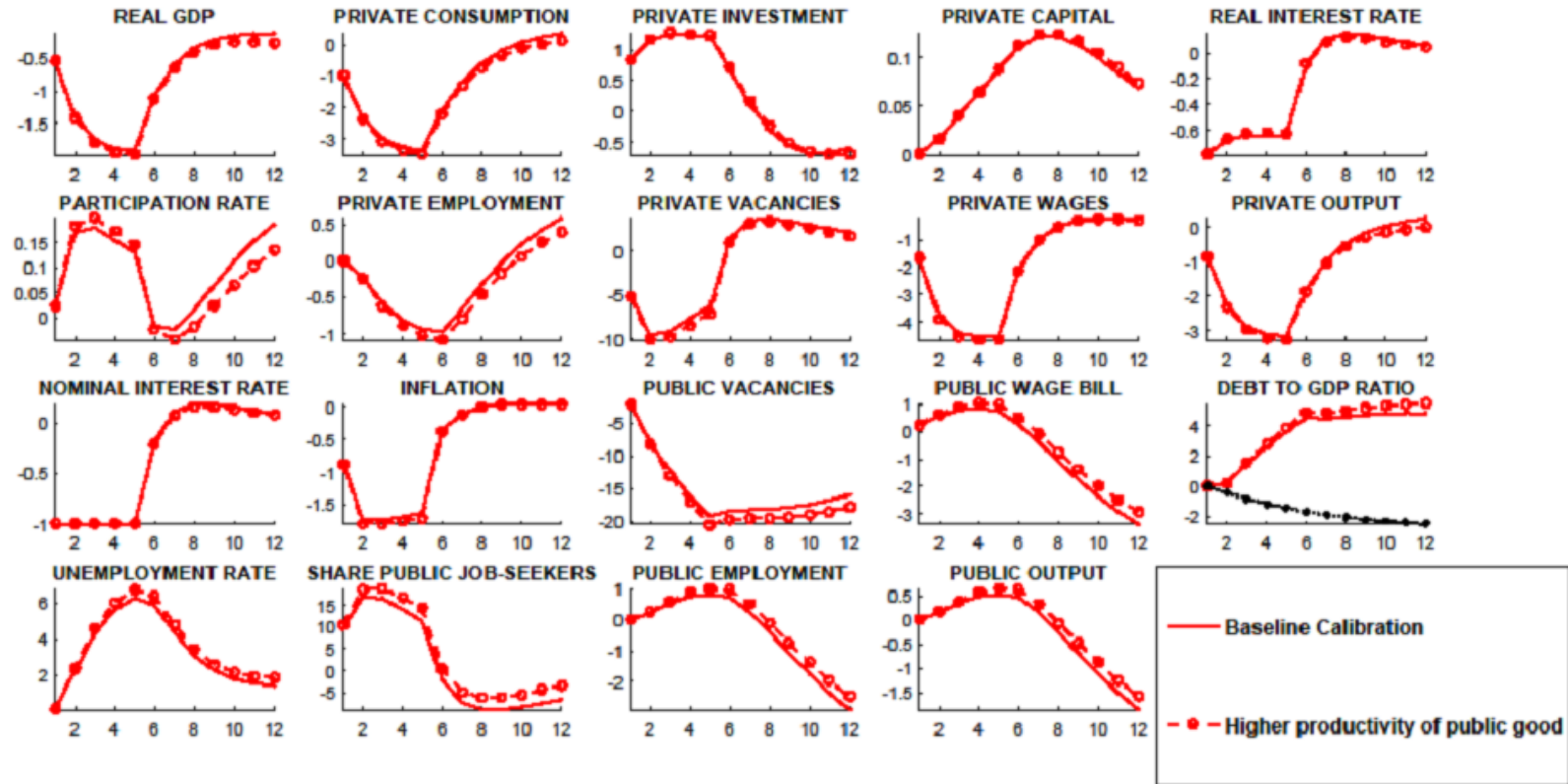
Graph 1.1.17.: Public Vacancy Cuts in Normal Times: Closed versus Open Economy



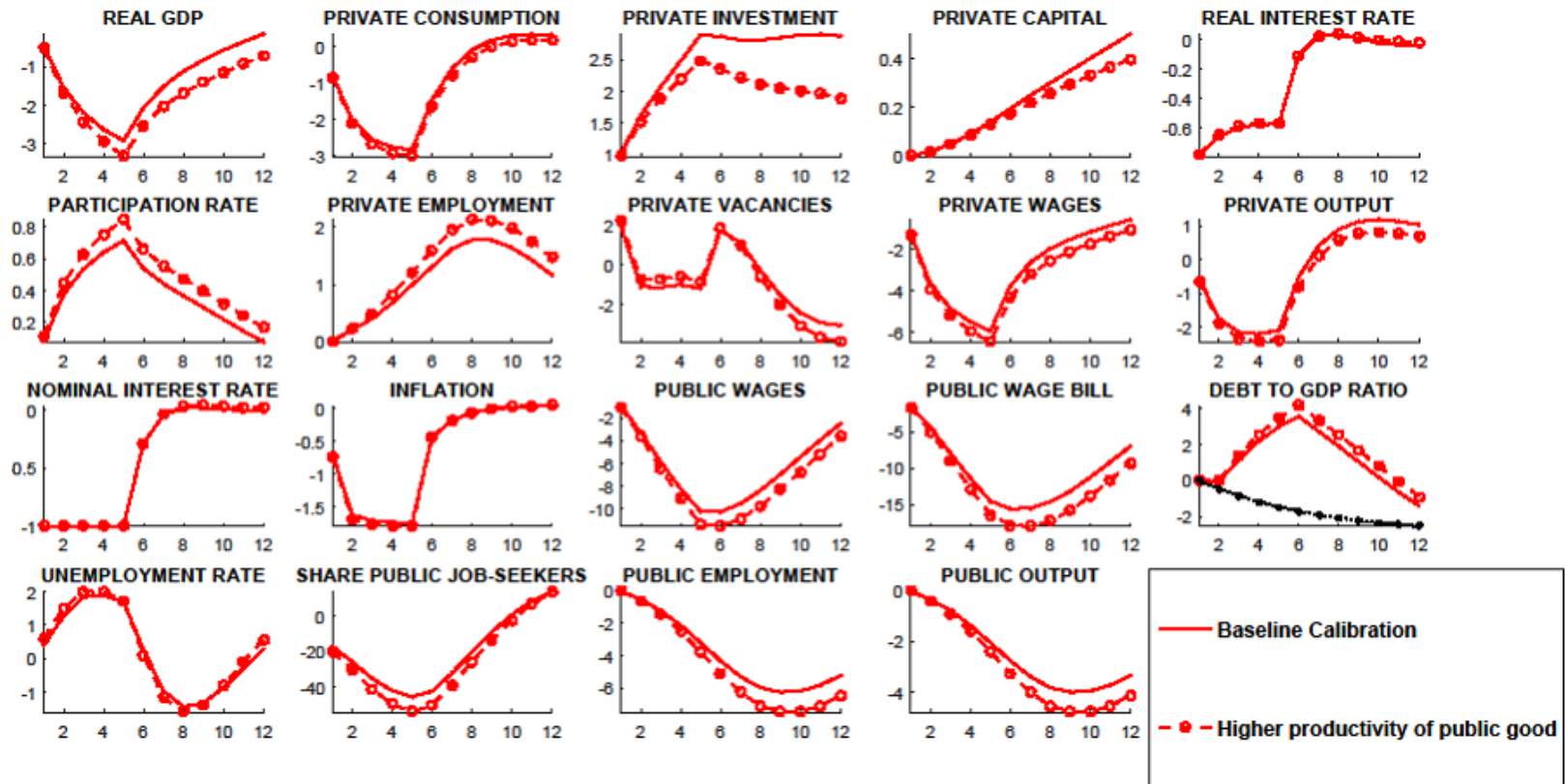
Graph 1.1.18.: Public Wage Cuts in Normal Times: Closed versus Open Economy



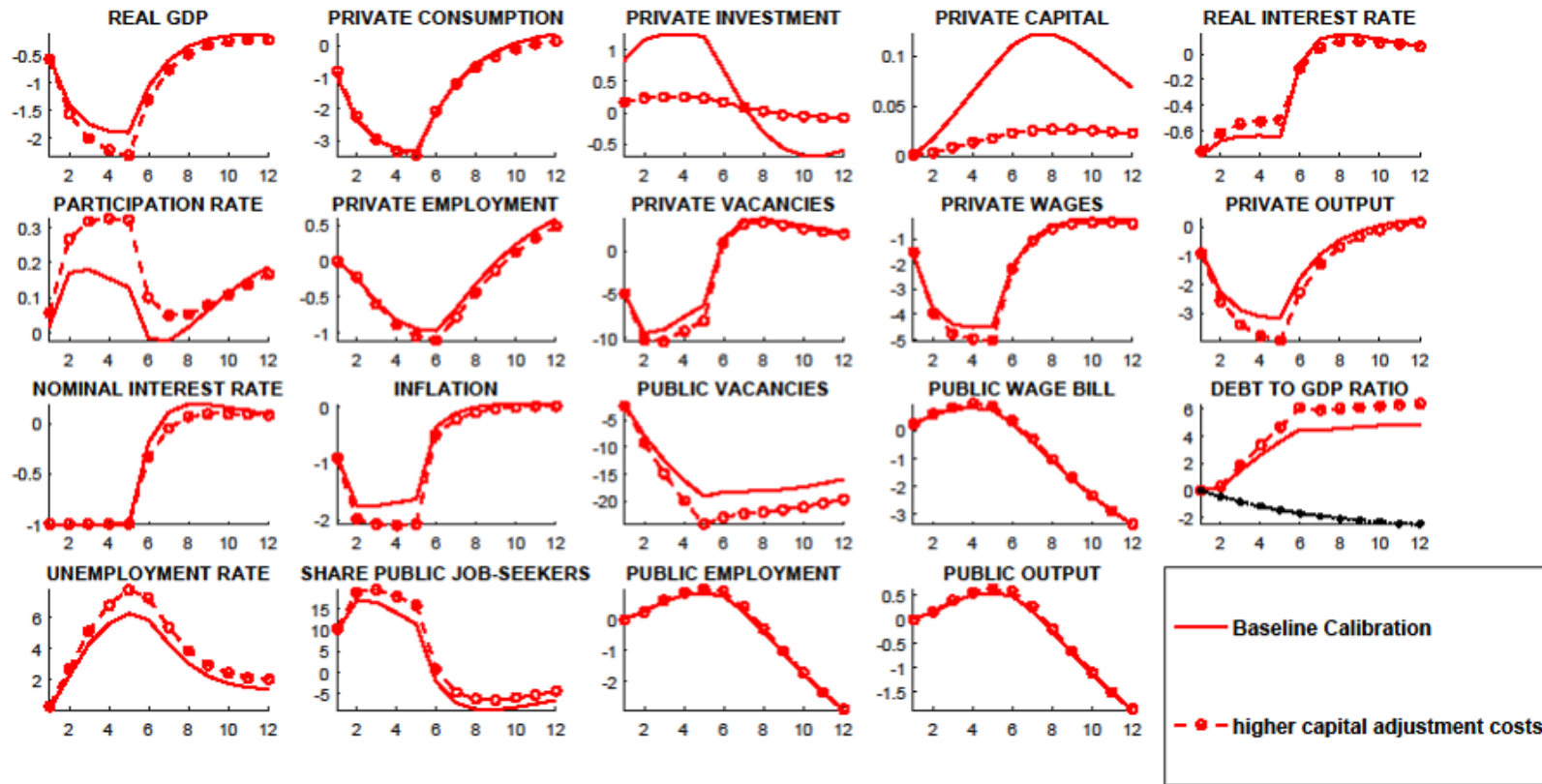
Graph 1.1.19.: Public Vacancy Cuts in a Low Inflation Environment: the Productivity of Public Output



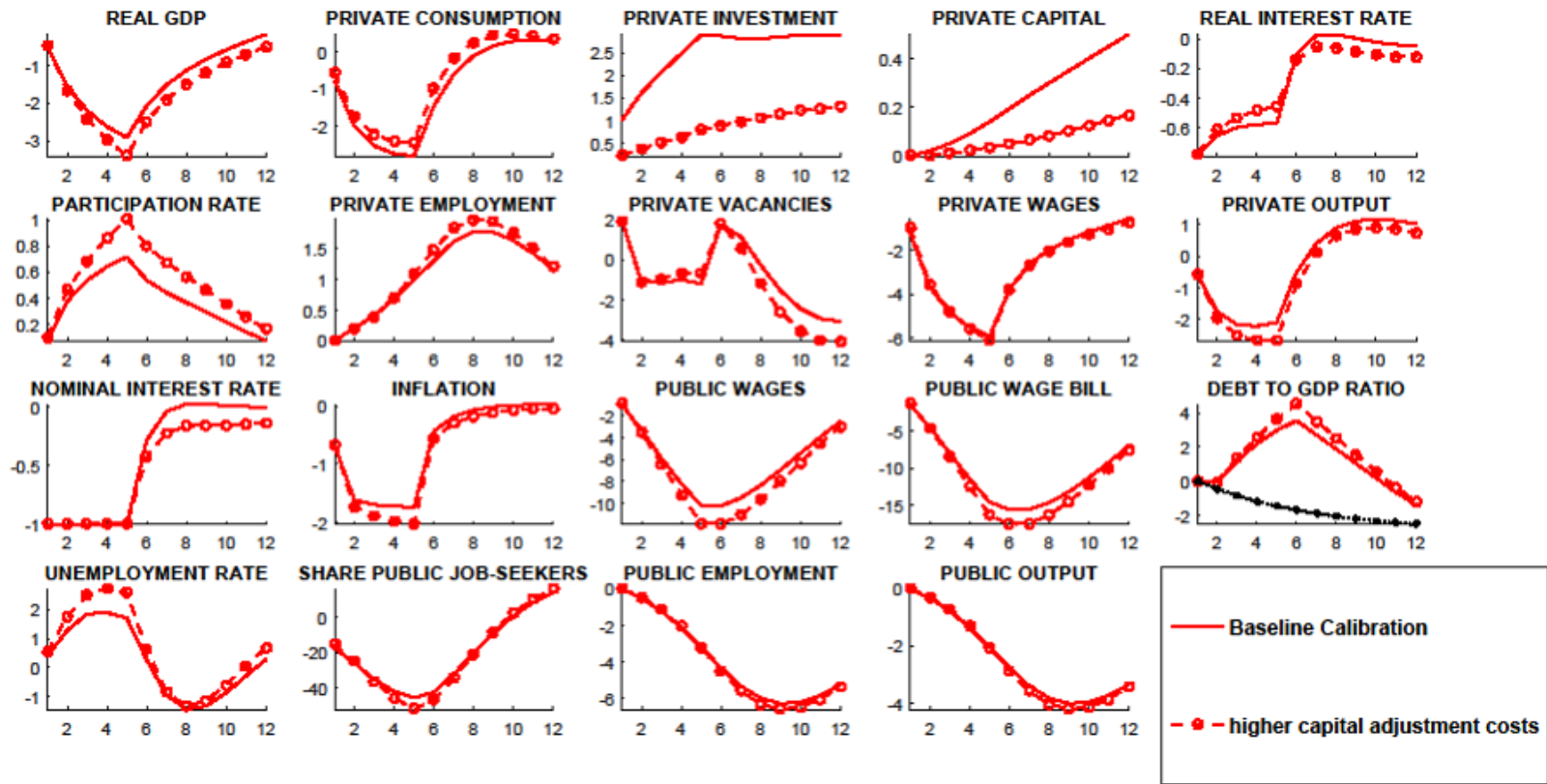
Graph 1.1.20.: Public Wage Cuts in a Low Inflation Environment: the Productivity of Public Output



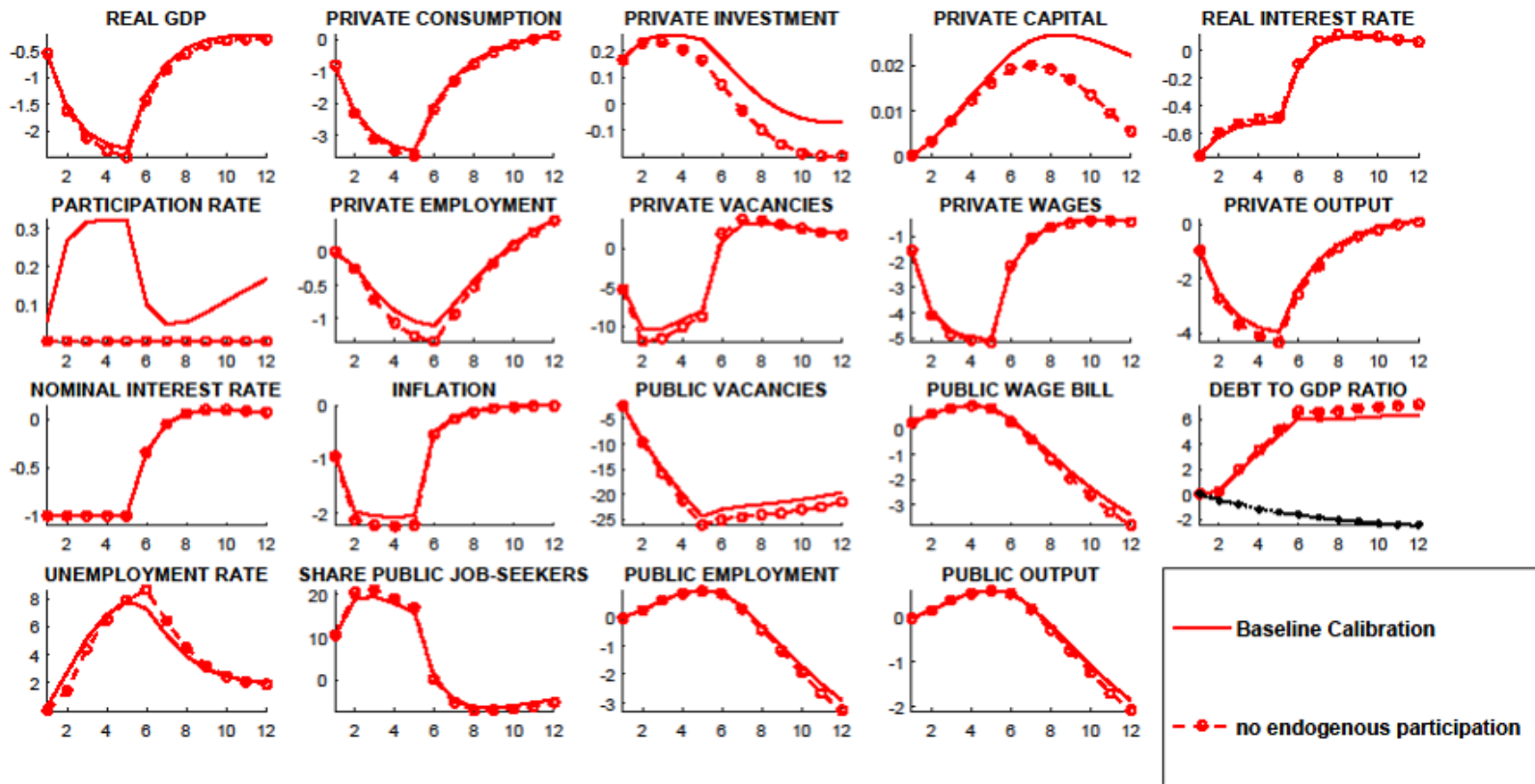
Graph 1.1.21.: Public Vacancy Cuts in a Low Inflation Environment: Investment Adjustment Costs



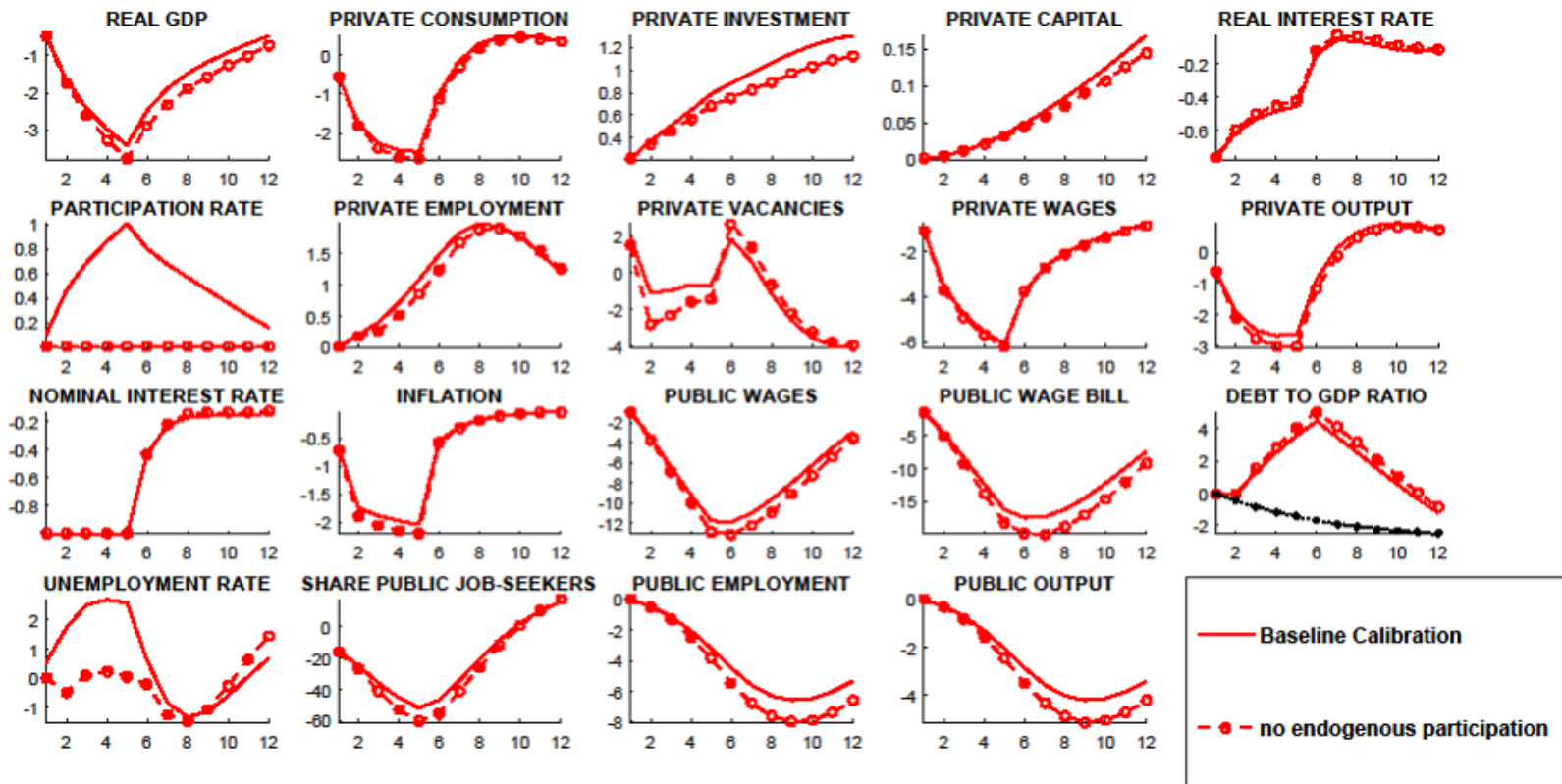
Graph 1.1.22.: Public Wage Cuts in a Low Inflation Environment: Investment Adjustment Costs



Graph 1.1.23.: Public Vacancy Cuts in a Low Inflation Environment: Endogenous labour Force Participation



Graph 1.1.24.: Public Vacancy Cuts in a Low Inflation Environment: Endogenous labour Force Participation



1.1.5. Discussion by Raf Wouters(*)

**Fiscal Consolidation in a Disinflationary Environment:
Price- versus Quantity-Based Measures**

Evi Pappa, Rana Sajedi and Eugenia Vella

Discussion by Raf Wouters (NBB)

“Fiscal Policy after the Crisis”
DG-ECFIN Workshop, Brussels, 19 January 2016

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interesting new and older insights

- Fiscal consolidation is less costly when the public sector is less productive.
- Price-based consolidation is more efficient for debt reduction than quantity-based consolidation strategies.

Results based on detailed labor market interaction between public and private sector.

- Fiscal consolidation in ZLB situation is hard: deflationary effects are reinforced.

Result based on joint shock analysis: simple but efficient analysis of state dependent fiscal multiplier.

- Short run cost versus long run gains from consolidation: fiscal rule can exploit the expectation channel more efficient.

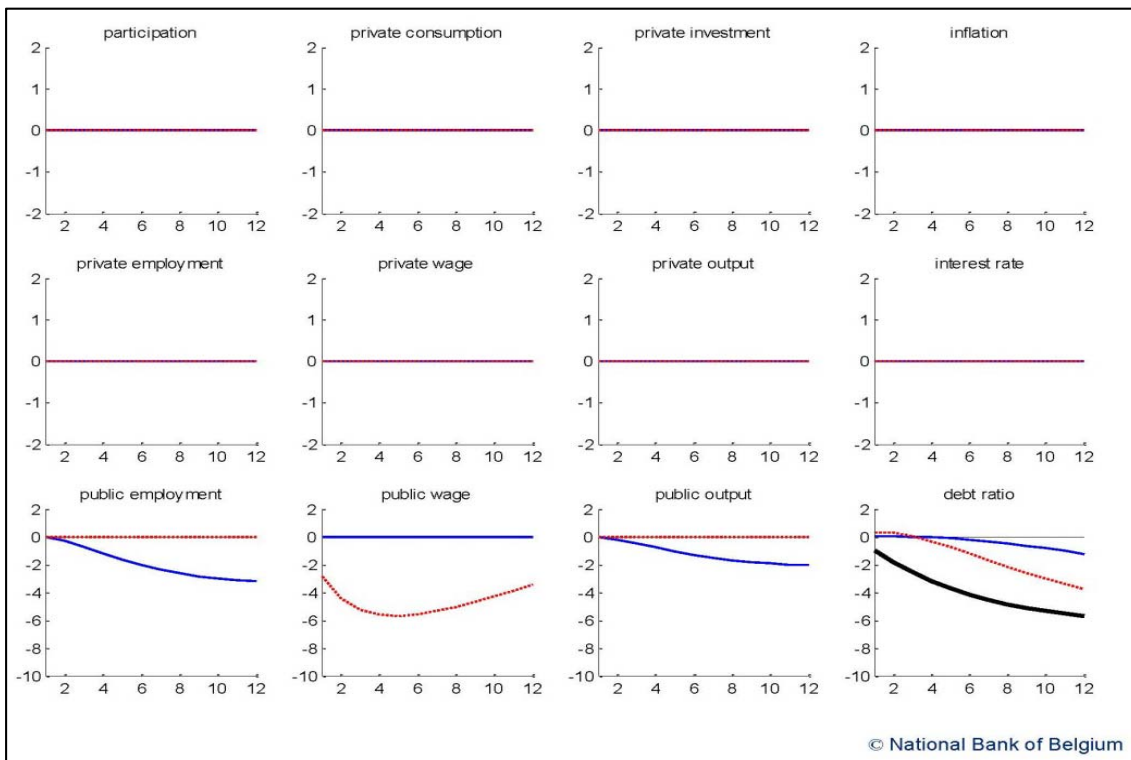
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Rich model for analysing fiscal consolidation / public sector downsizing

- The model contains a detailed transmission channel from public employment and wage decisions towards the private labor market.
- In order to understand the mechanism, I started from a simpler version and added the complications one by one:
 - No complementarity between private and public goods in consumption
 - No productive externalities from public goods to private sector productivity
 - No endogenous labor market participation
 - No integrated labor market: public sector employees do not search for a job in the private sector (dual labor market)
 - No private sector resources for public sector vacancy posting
- Under these assumptions: both public vacancies and public wages have no impact on the private sector. Fiscal consolidations do not affect private sector ! Both measures work very much like lump sum taxes.

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Rich model for analysing fiscal consolidation / public sector downsizing

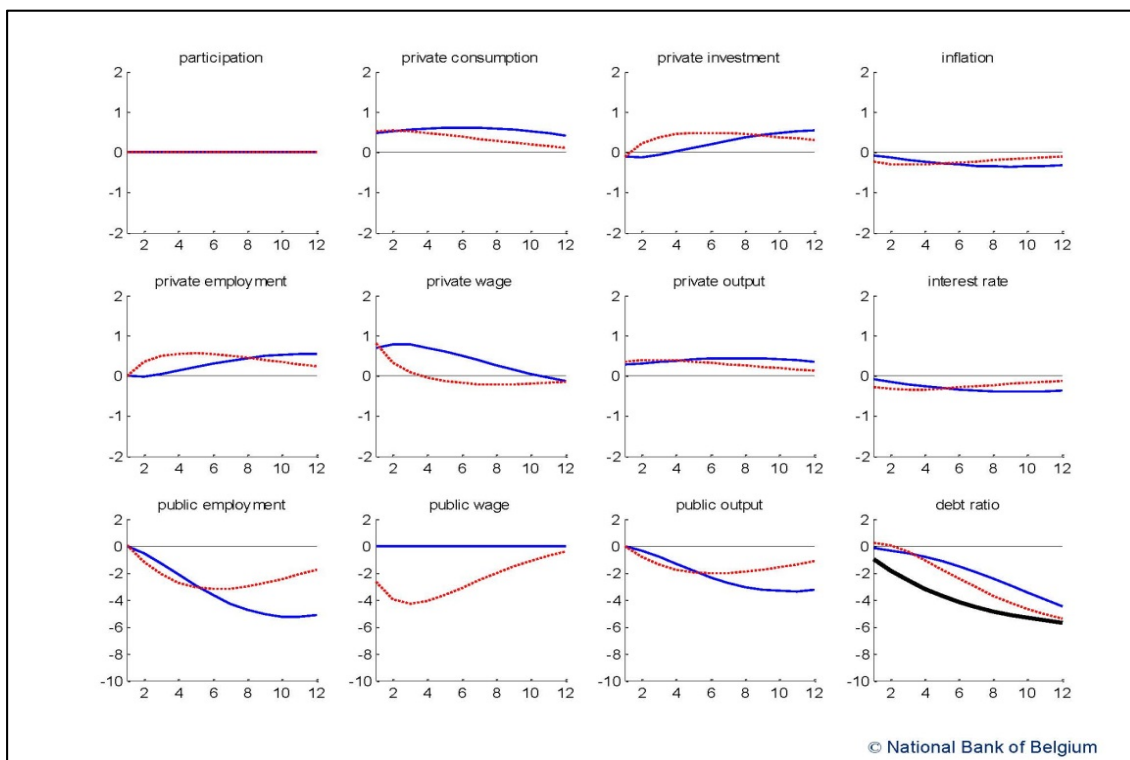
- The perfect integrated labor market is the crucial driver for the positive spillover effects from fiscal consolidation to the private sector labor market:

Dual labor market: fixed proportion of jobseekers are private/public sector workers

⇔ Full integration (first order condition no 28): households allocate the fraction of jobseekers that is looking for a job in the private/public sector so as to equalize the expected marginal value of being employed in the two sectors.

- Reducing public vacancies => search effort oriented towards private jobs
Reducing public wages => private jobs become more valuable
- More jobseekers for private sector => more matches => more private employment
Higher m_p and m_r => bargaining for higher wage in private sector

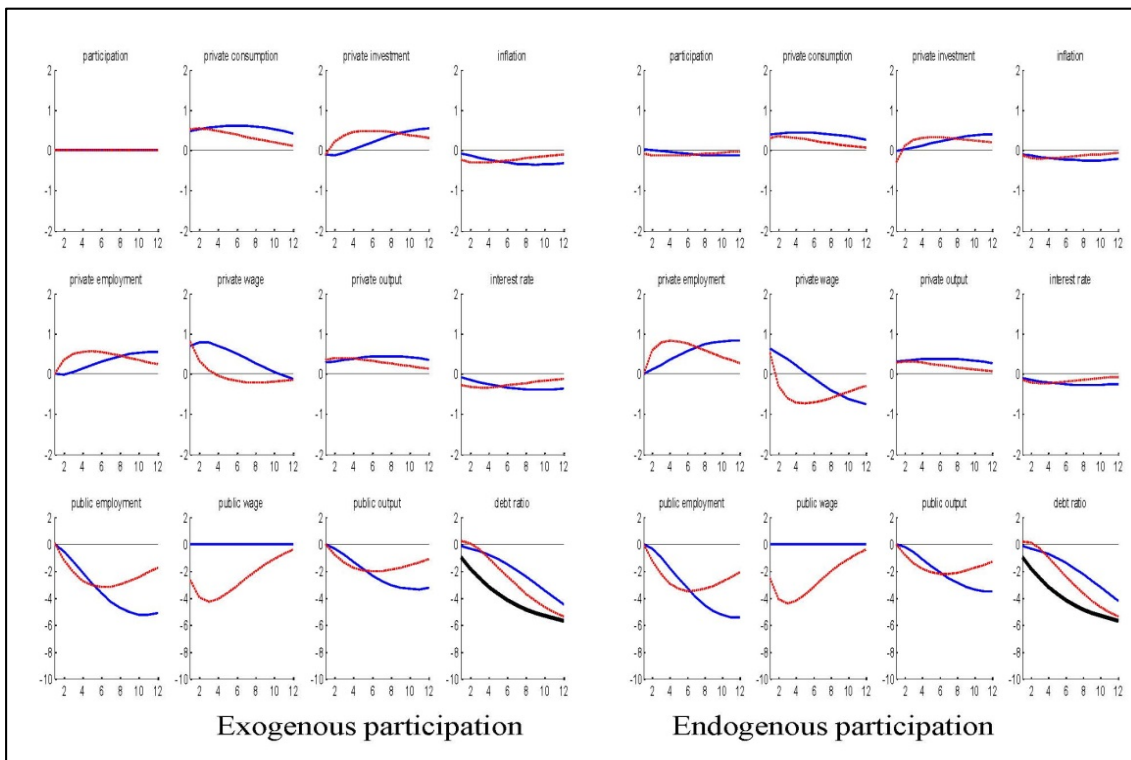
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Rich model for analysing fiscal consolidation / public sector downsizing

- The strong positive spillover effects via the integrated labor market are reduced by:
 - endogenous labor supply reaction;
 - negative productive externalities to private sector;
 - complementarity in private and public good consumption;
 - ZLB constraint.

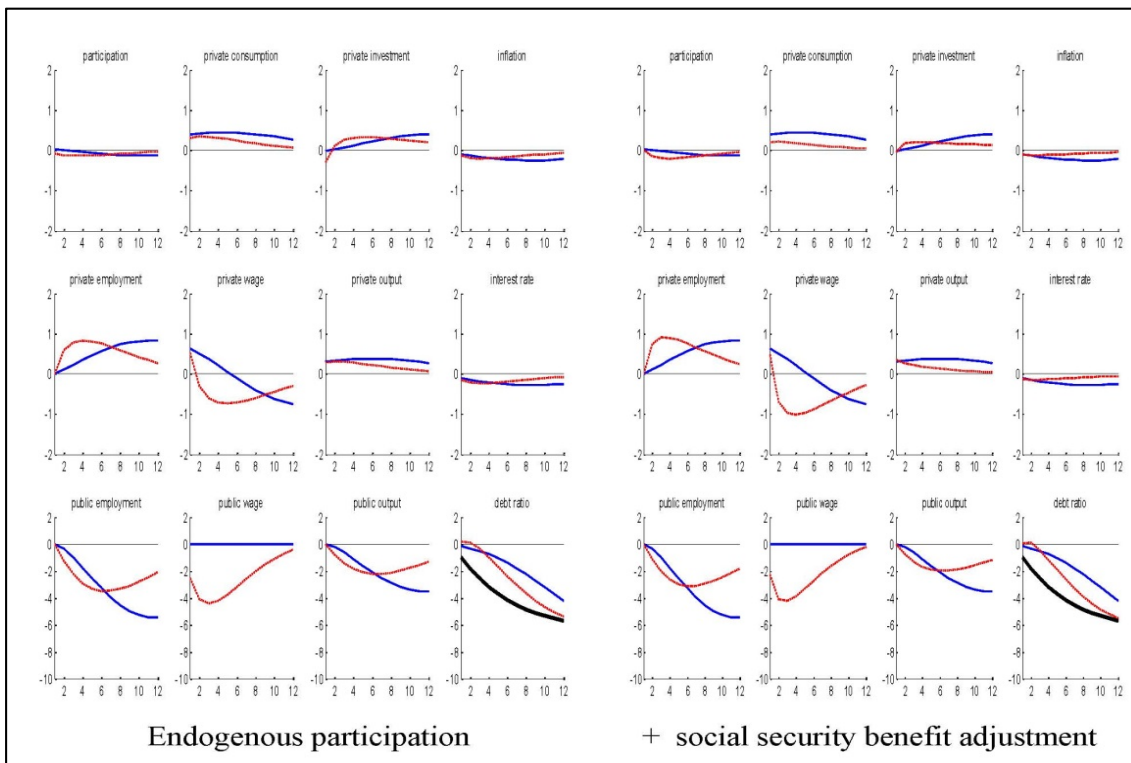
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Rich model for analysing fiscal consolidation / public sector downsizing

- Labor participation effect depends on calibration of labor supply elasticity: modest effect with low Frisch elasticity of labor supply (0.25).
- Endogenous labor participation reaction is further reinforced if unemployment benefits are decreased in parallel with public wages:
 - Social security benefits are important component of price based consolidation
 - With the calibration from the paper the impact remains moderate
- Missing liquidity constraint households to reinforce income effects.

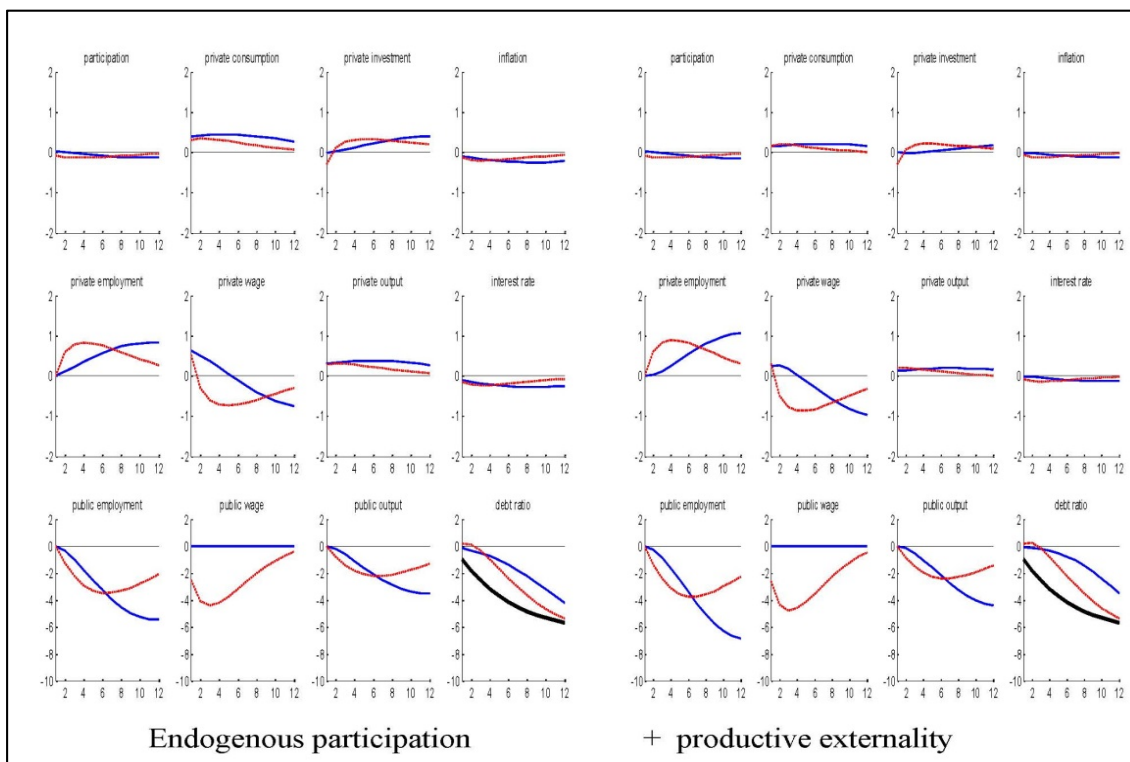
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Rich model for analysing fiscal consolidation / public sector downsizing

- Cutting public sector has negative productivity externality on private sector:
 - Evidence for calibration of this mechanism?
 - More standard mechanism operates via public sector capital stock or via human capital accumulation: more productive government expenditure have higher multiplier

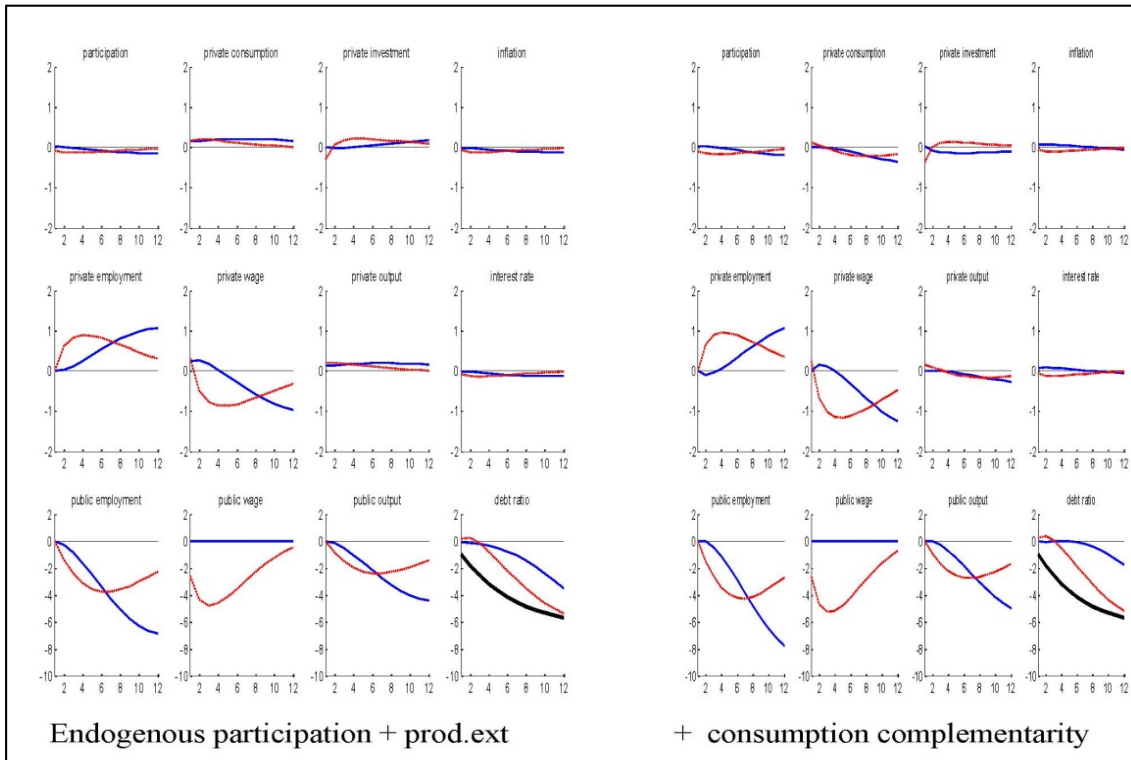
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Rich model for analysing fiscal consolidation / public sector downsizing

- Complementarity between private and public sector consumption: decline in public sector output reduces also consumption of private goods:
- Evidence for calibration:
 - Coenen, Straub, Trabandt (2012)
 - Feve and Sahuc (2014)

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interaction with ZLB constraint

- Impact on inflation and interest rate is moderate: no strong additional deflationary pressure ? Implication for ZLB remain modest
- most positive outcomes come with more negative inflation and interest rate outcomes => these positive scenario's become less likely in zlb situation
- Alternative channels with more nominal effects:
 - public sector leading/signalling for private sector wage: further downward cost pressure
 - See ECB-WDN network for empirical and modelling work on private-public wage interaction
- Impact of zlb crucially depends on the expected duration: in the reported simulations, this duration is very short, but nevertheless the constraint matters for the outcomes
 - How realistic is the modelling / calibration of other blocks?

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What I do not like ...

- Discount rate shock drives economy in the ZLB:
 - Private consumption declines but private investment is booming => risk premium shock or financial constraint necessary
- Lack of persistence in the model:
 - Capital adjustment costs, habit, indexation etc => missing persistence
- Fully predetermined employment – flexible hours worked
 - Adjustment via hours and employment matter
- No nominal wage stickiness:
 - Gali (2011): important role for nominal wage stickiness for unemployment

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other sources of state dependent fiscal multipliers

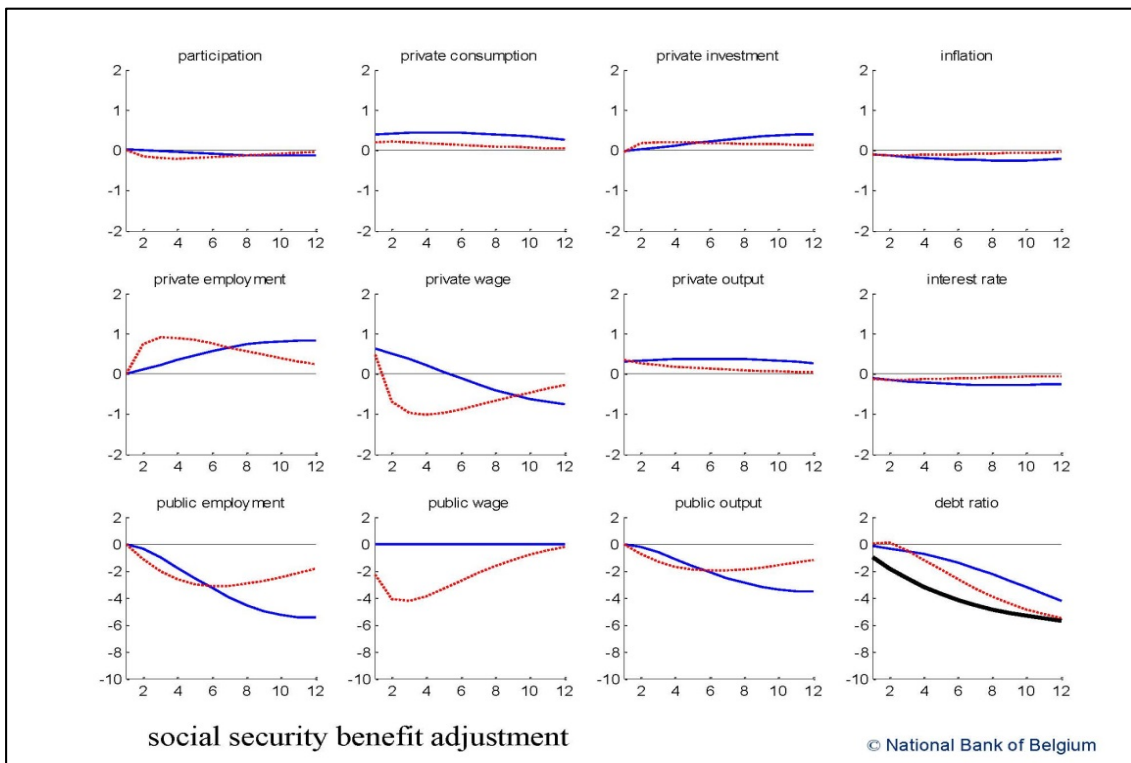
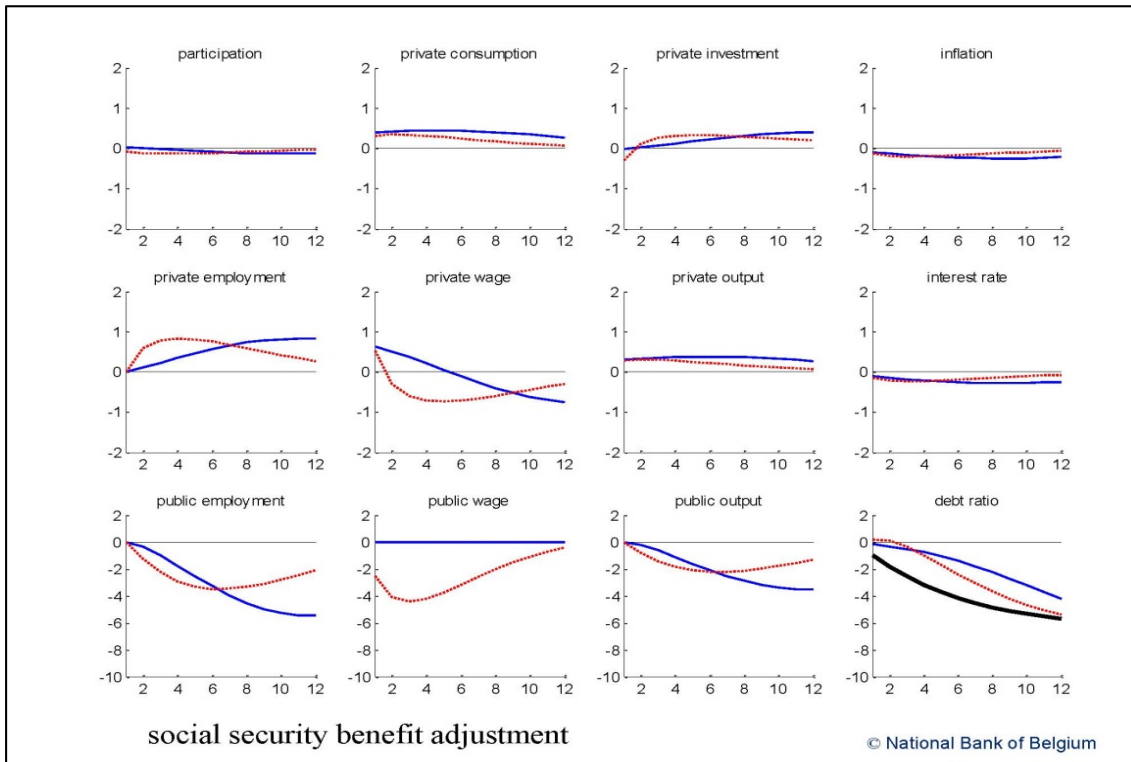
- ZLB is not only situation that affects the fiscal multiplier: state dependence of the fiscal multiplier is more general
- Recessions and high unemployment can make fiscal austerity measures more costly:
 - job rationing in private sector during recession (Michaillat 2015)
 - hysteresis in unemployment (Gali 2015)
 - persistence in job creation (Rendahl 2015)
- Financial conditions:
 - endogenous sovereign default risk channel: (Roeger and in't Veld 2012)
 - very important in European experience

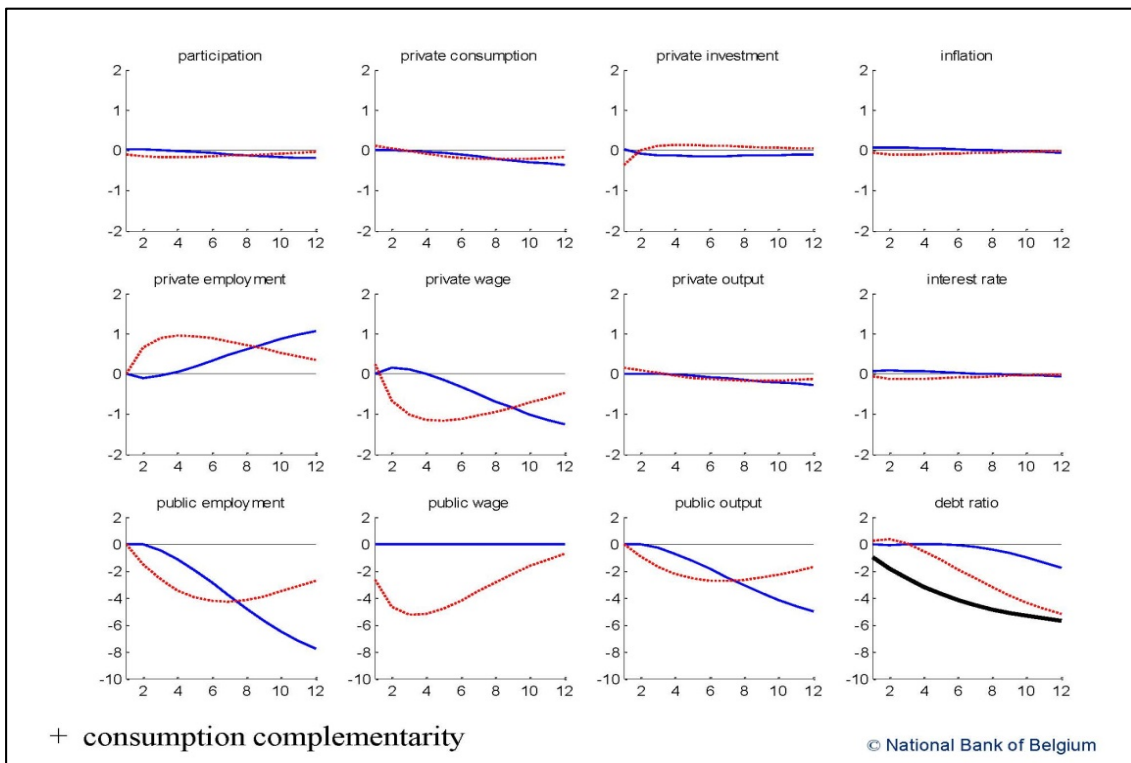
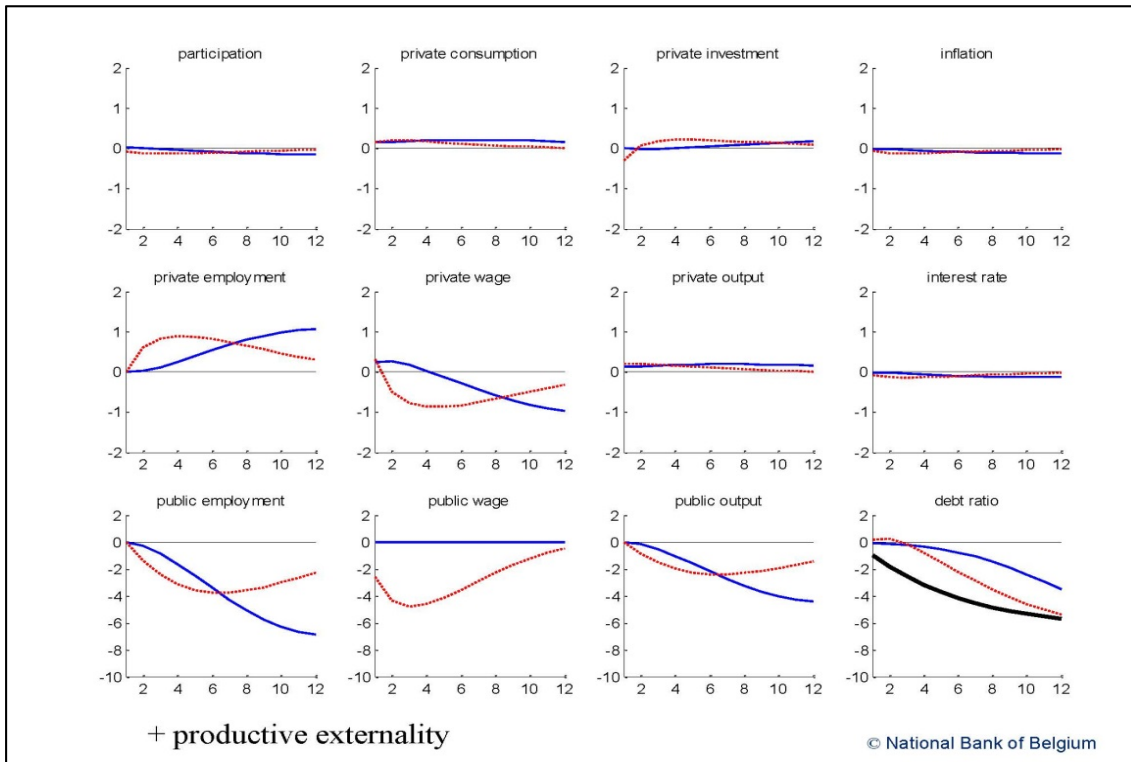
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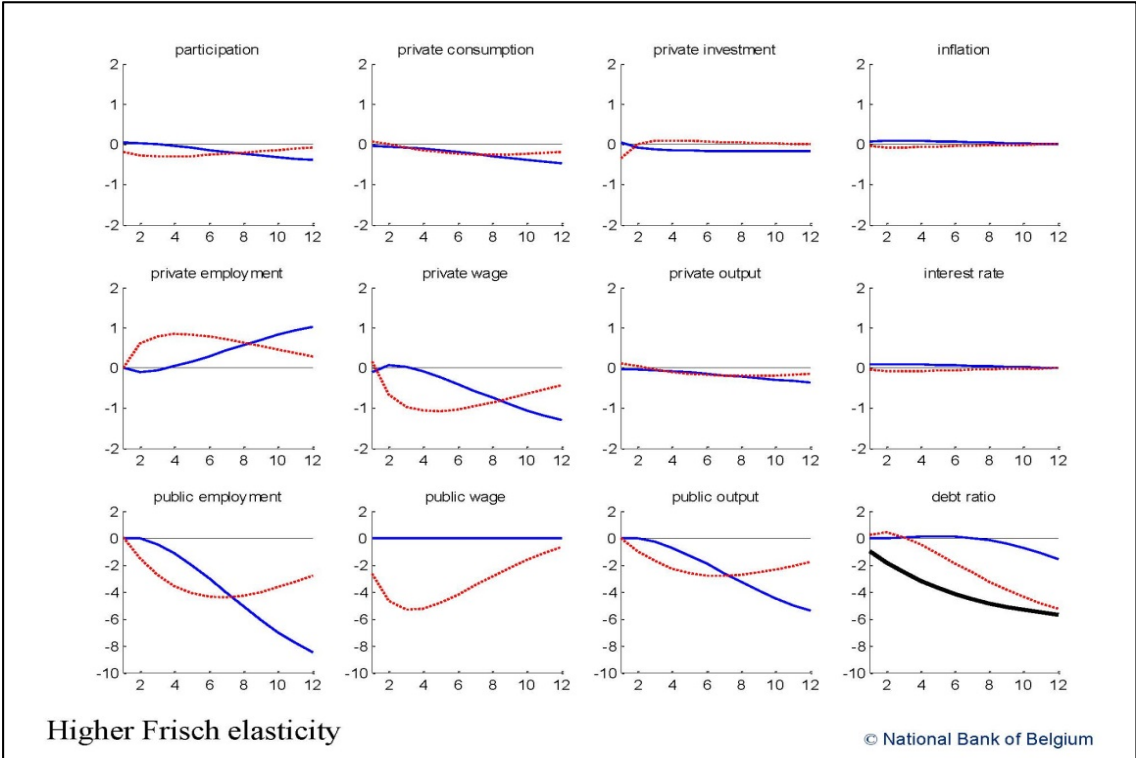
to conclude

- Interesting and rich model for analysing the impact of fiscal consolidation on the labor market
- Look forward to the empirical version: estimation should clarify magnitude of the various channels

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1.2. PUBLIC FINANCES AND INFLATION: THE CASE OF SPAIN⁽¹⁰⁾

By Pablo Hernández de Cos, Samuel Hurtado, Francisco Martí, Javier J. Pérez()*

1.2.1. Introduction

Advanced economies currently face the challenge of understanding the economic effects of a low inflation regime. In the particular case of Spain (see Graph 1.2.1.), the traditional positive inflation differential with the euro area turned negative since the inception of the economic and financial crisis, and perspectives of low inflation dominate nowadays the opinion of public and private analysts. The literature has recently signalled that low inflation or deflation can challenge the operation of fiscal policies through a number of channels,⁽¹¹⁾ particularly in episodes of fiscal retrenchment.

We empirically explore the influence of inflation on fiscal variables, such as government revenues, expenditure and debt, for the particular case of the Spanish economy. Our aim is to draw policy lessons for the design of the ongoing rebalancing process of the main fiscal aggregates in a low inflation environment. Indeed, while Spanish public finances are in a correction path since 2010, still high deficits and debt levels are registered by the different public administrations.⁽¹²⁾ In addition, the yields of a number of structural fiscal measures implemented are contingent on the future path of inflation (in particular, pension reforms). We will take throughout the paper the current low inflation environment as given, without entering into its possible causes.⁽¹³⁾

Against this framework, we assess, first, the (short-term) influence of inflation on fiscal adjustment strategies, in order to draw policy lessons for their design in a context of low inflation. In particular, we explore the implications of different inflation scenarios for public debt downsizing,⁽¹⁴⁾ the effectiveness of public spending measures (by looking at measures designed to contain public wage and pension spending), and the evolution of nominal government revenues in the exit process from the economic crisis. To put our analysis into perspective, we compare the current environment with the one experienced by the Spanish economy at the time of the exit phase from the previous economic recession (second half of the 1990s). While now prospects are of a low inflation environment, coupled with low interest rates and moderate economic growth, the 1990s recovery took place in a moment of more elevated inflation rates, interest rates and real GDP growth.

⁽¹⁰⁾ The opinions expressed in this paper are those of the authors and not necessarily reflect those of the Banco de España or the Eurosystem. We thank Roberto Ramos for his help with the simulations on the impact of inflation scenarios on pensions, and participants in DG ECFIN's Workshop "Fiscal policy after the crisis", in particular Werner Roeger, for their comments.

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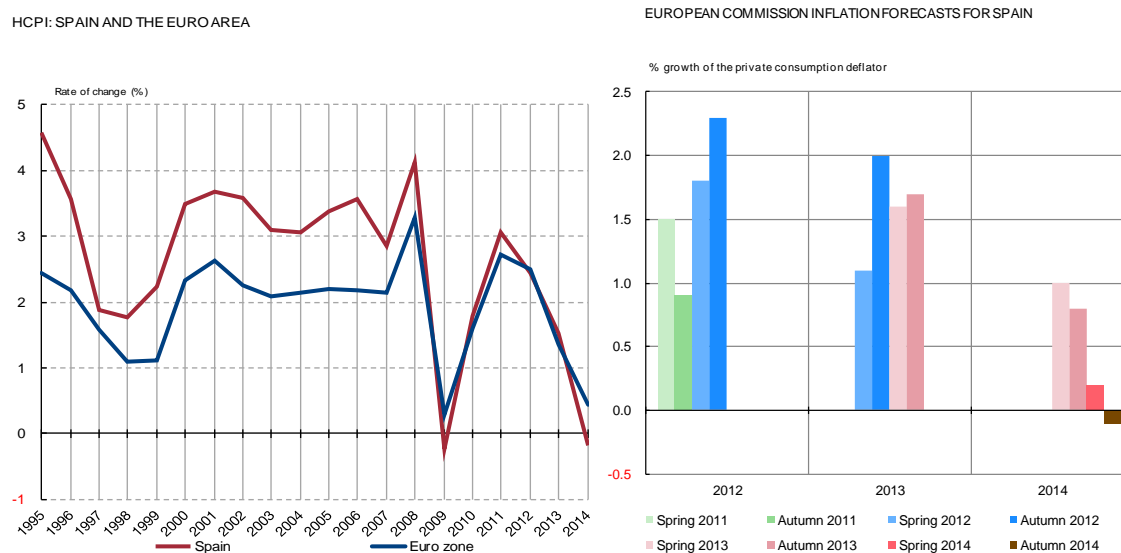
⁽¹¹⁾ See among others End et al. (2015) and the references quoted therein.

⁽¹²⁾ See Martí and Pérez (2015).

⁽¹³⁾ A number of explanations have been provided in the literature. Factors behind the current low inflation situation include some of a structural nature, like the deregulation of labour markets, the trends in cost-competition between countries, the influence of commodity prices worldwide, or the impact of technological progress (through increased competition by lowering barriers to entry), and others of a more conjunctural nature.

⁽¹⁴⁾ Trying to grasp the necessary additional fiscal effort to compensate for a low inflation environment.

Graph 1.2.1.: Recent trends in inflation and inflation expectations in Spain



Source: National Statistics Institute.

Second, in order to complement the previous exercises, we provide a quantitative assessment of the impact of inflation "shocks" on the main fiscal aggregates through the lens of a macroeconomic model. Certainly, the impact of an "inflation shock" depends on the source of the shock, given that inflation is a variable endogenous to the economic situation. Understanding the latter is crucial to evaluate the public finance effects of the shocks. Accordingly, we characterize "shocks" of different nature that push prices down by the same amount (one percentage point) using the Quarterly Model of Banco de España (MTBE, see Hurtado et al. 2014): an internal inflation shock and an external inflation shock. The "internal shock" is engineered as a reduction in Spanish firms' mark-ups, while the "external" one is modelled through a reduction of the price of oil in international markets. The two shocks generate very different responses of public sector variables.

Finally, in order to assess the medium-term impact on pension expenditure of a permanent low-inflation regime, we analyse the link between inflation scenarios and the effectiveness of a key piece of the most recent pension reform, namely the "revaluation index" (see Ramos, 2014). Indeed, Sánchez (2014) states that a persistently low level of inflation could be as harmful for the success of the reform (in the long term) as poor immigration and productivity.

The structure of the rest of the paper follows the description of empirical exercises outlined in the previous paragraphs. Thus, in Section 1.2.2., we look at the impact of inflation on fiscal adjustment strategies, in Section 1.2.3., we provide a quantitative assessment of the impact of inflation "shocks" on public finances through the lens of MTBE model, and in Section 1.2.4. we assess the linkage between pension expenditure and low-inflation. Finally, in Section 1.2.5. we provide some concluding remarks.

1.2.2. Some accounting exercises

1.2.2.1. Public debt dynamics and inflation

In this section we use the standard decomposition of public debt changes into its fundamental drivers (primary budget balance, interest payments, real GDP, the GDP deflator and the deficit-debt adjustment, see e.g. Hall and Sargent, 2010) to compare the public debt consolidation experiences of two periods of "fiscal stress", namely the most recent one, and the one of the 1990s. We carry out this exercise because the two periods present significant differences as regards average inflation. While the latter was a period of moderate/high inflation, compared to historical averages, the former is a period of low inflation. Thus, the comparison provides a natural framework to illustrate the impact of inflation on government debt adjustment processes.

Let Y_t be nominal GDP and let D_t be the nominal value of government debt, both at time t . The government budget constraint accounts for how nominal interest rate i_t , net inflation π_t , net growth in real GDP, g_t , the net-of-interest deficit as a percent of Y_t , p_t , and the deficit-debt adjustment, DDA_t , combine to determine the evolution of the government debt-to-GDP-ratio,

$$\frac{D_t}{Y_t} = \frac{1 + i_t}{(1 + \pi_t)(1 + g_t)} \frac{D_{t-1}}{Y_{t-1}} + p_t + \frac{DDA_t}{Y_t} \quad (1)$$

were the nominal yield i_t and the stock of debt D_t are averages of pertinent objects across times to maturity. A standard, approximated version, suitable for accounting decomposition of the fundamental determinants of debt, takes the form

$$\frac{D_t}{Y_t} = (1 + i_t - \pi - g_t) \frac{D_{t-1}}{Y_{t-1}} + p_t + \frac{DDA_t}{Y_t} \quad (2)$$

With this decomposition it is possible to analyze, in particular, the sizeable impact that changes in prices may exert on the dynamics of the public debt to GDP ratio. In Graph 1.2.2. we assess these effects as well as the contribution of the other determinants described in equation (2), for two distinct periods of fiscal consolidation of the Spanish economy, both starting at a local maximum of the series of government deficit over GDP. The upper panel starts in 1993, the lower panel starts in 2009, and we analyze the subsequent evolution of the debt-to-GDP ratio over 6 years. In the former period, inflation averaged 3.6% per year while in the latter average inflation was substantially lower at 1.4% per year.

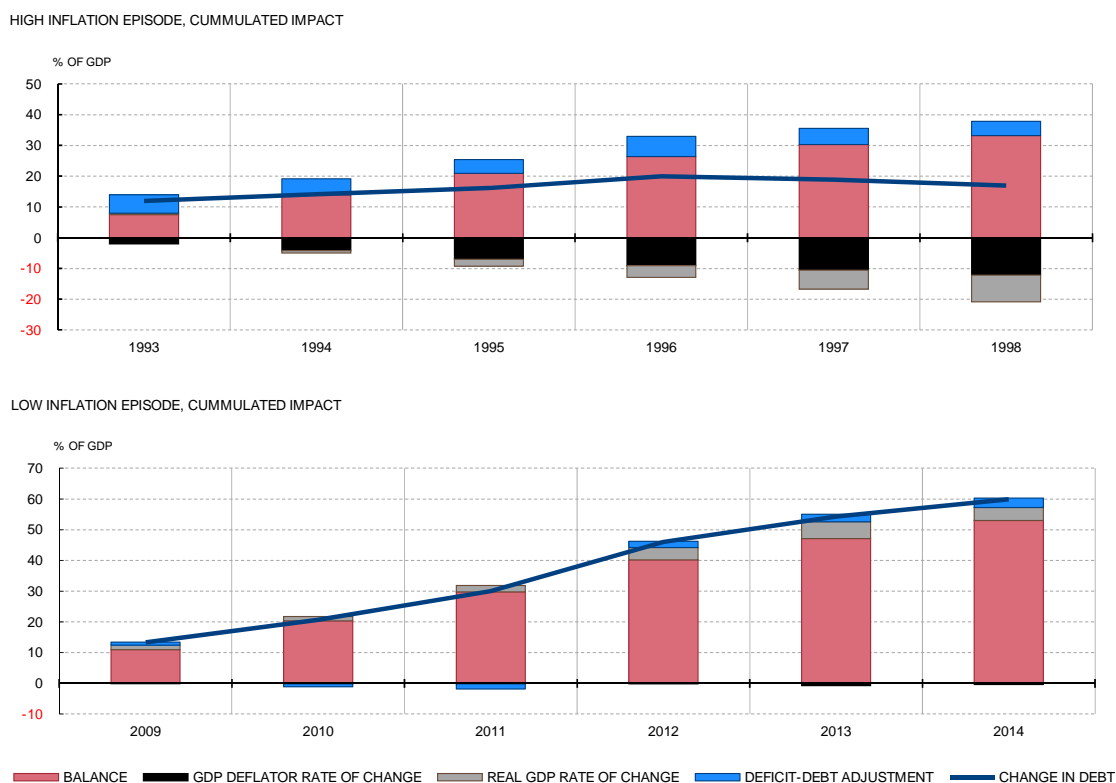
The illustration is quite telling regarding the issue at hand. In the upper panel, the dynamics of prices allowed a reduction of the government debt to GDP ratio of above 12 percentage points of GDP, while in the more recent, "low inflation" episode the contribution of inflation to debt reduction has been almost negligible. For the evaluation of forward-looking sustainability risks, the dynamics of the ratio are even more important than the level of public debt over GDP. Indeed in the 1990s episode the ratio of public debt to GDP already got stabilized at $t+3$, while in the most recent episode debt over GDP kept growing still over the defined $t+6$ window.

1.2.2.2. The effectiveness of public spending discretionary measures and inflation

The direct, ex-post budgetary savings derived from some cost-cutting public spending discretionary measures with respect to a no-policy-change alternative depend on the inflation scenario. In

particular, when public spending measures apply to items typically linked to the inflation rate. For instance, in Spain public wages have been traditionally revalued, as a baseline, in line with expected inflation, as defined by the medium-term ECB target of 2%, while as regards pensions, the usual reference has been the current-year inflation outcome (November year-on-year growth rate). If the policy actions consist in breaking the link between the evolution of public wages and pensions with inflation, their budgetary impact would certainly be more relevant in a high inflation environment.

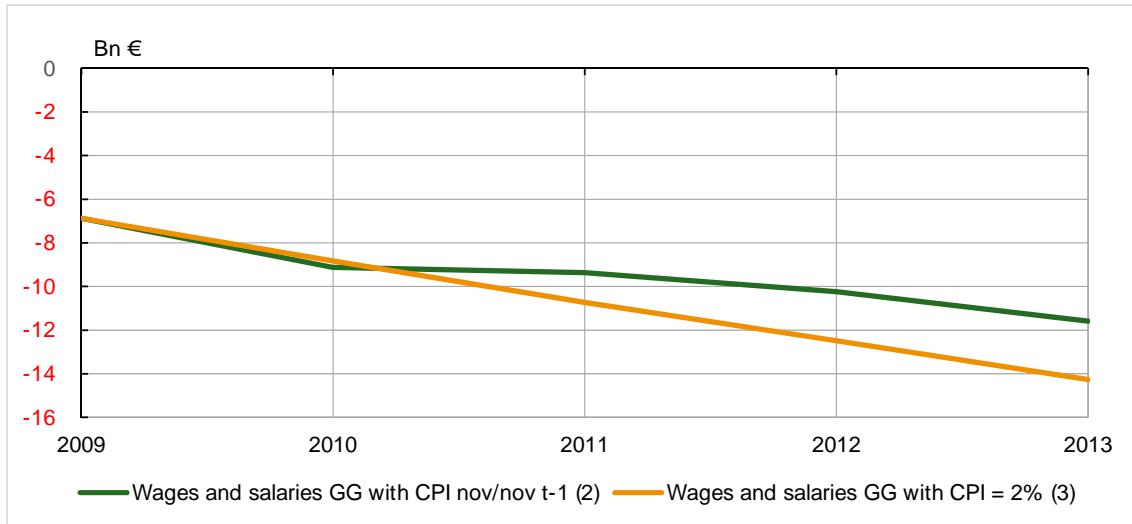
Graph 1.2.2.: Determinants of the change of public debt in Spain: fiscal consolidation episodes of the 1990s and current



Source: Authors' calculations

We simulate the savings of the adjustment in public wages per employee implemented over 2009-2014 vis-à-vis two benchmark growth alternatives, namely a 2% yearly rate (in line with the traditional inflation reference for public wages) and the current-year inflation rate (that averaged 1.4% over 2009-2014). As regards discretionary measures, over that period, public wages were frozen year-by-year, and in addition in 2010 there was a 5% nominal cut across the board (see Martí and Pérez, 2015). The results are presented in Graph 1.2.3. The cumulated differential savings of these measures with respect to the 2% benchmark amounts to 14.3 bn euro, which is close to 1.5% of Spanish GDP. This is almost 2.7 bn euro (0.3% of GDP) additional saving compared to a situation of 1.4% average inflation growth. This shows that such measures, defined in nominal terms, deliver less budgetary savings in a low inflation environment.

Graph 1.2.3.: Impact of cost-cutting public wage measures with respect to two benchmark scenarios of inflation (2% and historical)



Source: Authors' calculations

1.2.2.3. Public revenues and inflation

In this section we explore the limits to tax collection that may exist in a low inflation environment despite a perceived real recovery of the economy. To do so we break down standard nominal tax bases for the different revenue items into a real and a "price" part. This approach requires, first, the identification of the appropriate nominal tax base for each revenue item (VAT; income tax; corporate tax; social security contributions), and, second, the separation of its approximate real and deflator parts. The latter may involve the use of estimation methods in the cases in which the decomposition of nominal macroeconomic variables into their real and deflator parts is not available. We follow the standard approach in the extant literature to approximate macroeconomic bases. In their definition, though, the availability of national accounts data conditions these choices (see e.g. Morris et al., 2009, or Leal et al., 2008).

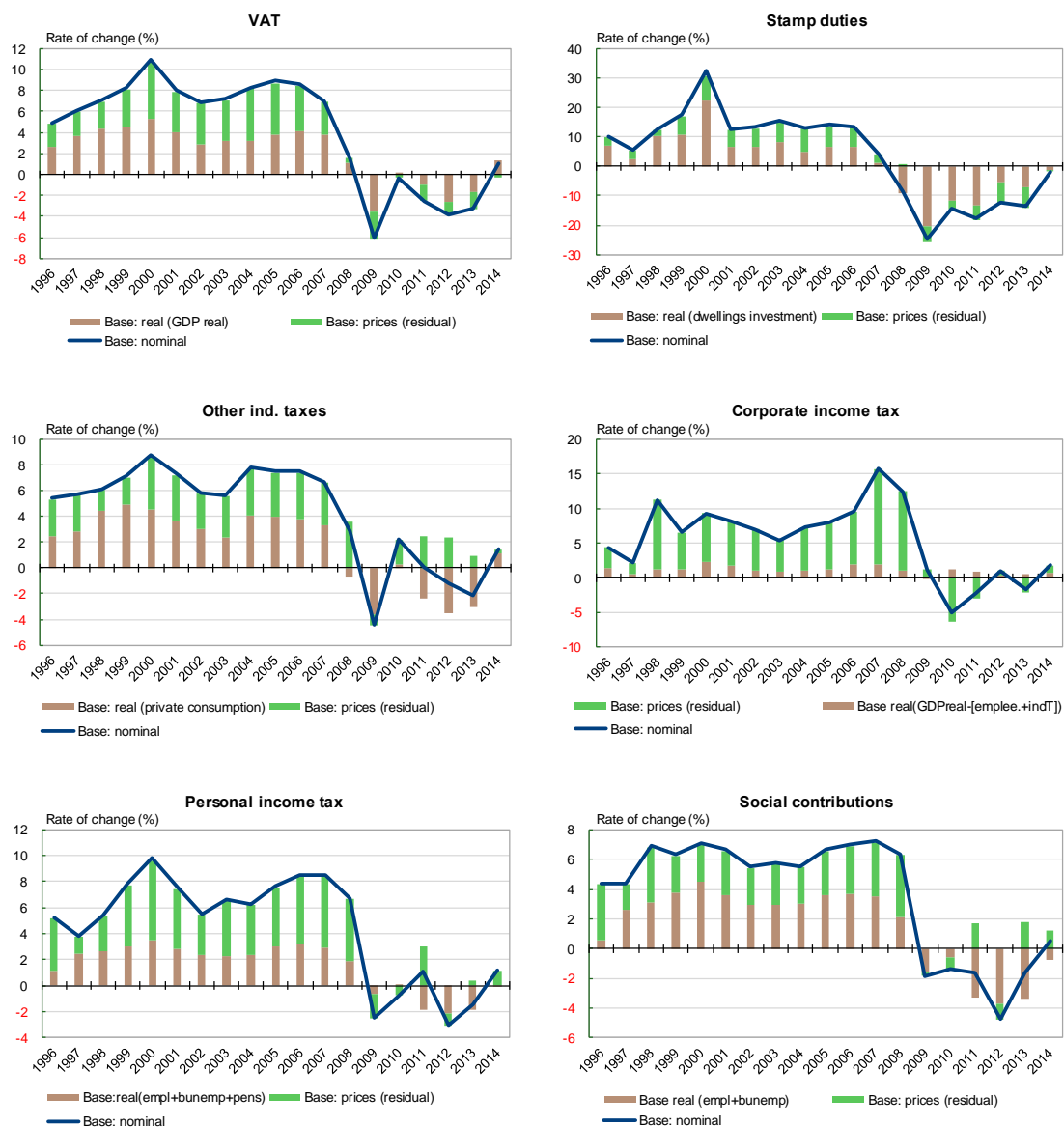
As regards VAT, we take as nominal tax base private households' consumption, household's investment, tourism revenues, and general government intermediate consumption and investment. As the average deflator of these components we take the GDP deflator, and then compute the real component as a residual using the nominal tax base. Regarding Stamp Duties, we take as its tax base housing investment, taking its deflator as the measures of prices in this case. As to other indirect taxes, we approach the evolution of those bases by private consumption, and the decomposition follows the real-deflator decomposition of the national accounts.

With respect to direct taxation, we approximate the tax base of personal income taxes by compensation of employees, non-wage household income, including interests and dividends, minus actual social contributions paid to the general government, and adding social payments. As regards corporate income taxes, national accounts tax bases are more difficult to identify. We take, as it is standard in the literature the gross operating surplus of firms. The deflator is estimated from the income side of GDP. Finally, as an approximation of social security contributions we take compensation of employees and non-employees. As regards personal income taxes and social

security contributions, the real component is estimated by the number of taxpayers, workers and social benefits' beneficiaries in the former case and workers in the latter.

In Graph 1.2.4. we present the decomposition of such tax bases into their real and deflator part. We focus on a couple of examples. First, as regards VAT out of the 4.9% growth in 1996, close to 50% was due to the real part and the other 50% to the price part, while in the first year of recovery from the latest recession the nominal growth of tax bases took place in a framework of falling prices. Second, as regards the two lower panels of the graph, wage moderation, that partly reflects low inflation, explains why tax collection on the verge of the late 2013 recovery has remained relatively subdued.

Graph 1.2.4.: Government revenues and inflation: decomposition of nominal revenue macroeconomic bases between its real and price parts



Source: Authors' calculations

Nevertheless, the relevant object from the point of view of the fiscal adjustment is the impact on the government revenue-to-GDP ratio, not just on the nominal value of government revenues. From the latter point of view, the final effect would depend on the net impact on the numerator (nominal public revenues) and the denominator (nominal GDP). Related to this point, one may wonder if inflation forecast errors are behind forecast errors in planned government revenue-to-GDP ratios. In particular, a relevant question is to what extent negative news on government revenues could be related to lower-than-expected inflation rates. The latter is a complex question that would deserve a deep analysis that goes well beyond the aim of the current paper. In any case, as a first, extremely tentative approximation, we run the following simple regression:

$$\left(\frac{R_t}{Y_t} - \frac{R_{t-1}}{Y_{t-1}}\right) - \left(\frac{\widehat{R}_t}{\widehat{Y}_t} - \frac{\widehat{R}_{t-1}}{\widehat{Y}_{t-1}}\right) = \alpha(\pi_t - \widehat{\pi}_t) + \beta(g_t - \widehat{g}_t) + \varepsilon_t \quad (3)$$

Where R_t denotes government revenue, and as described above Y_t is nominal GDP, π_t the inflation rate (GDP deflator) and g_t the real growth rate of GDP. A hat over a given variable denotes a forecast. Thus, we relate forecast errors in the dynamics of the ratio of the government revenue-to-GDP ratio to forecast errors in inflation and economic growth. The series of forecasts are computed by combining real-time forecasts from international organizations (European Commission, IMF and OECD) and official (government) plans. We compute monthly series that reflect in each month the latest available forecasts (for the current year and one-year-ahead), taking the perspective of the external analyst that processes incoming sources of forecast by informed agents. We run the regressions at the quarterly frequency (forecasts are averaged over the 3 months of a given quarter) over the period 1999Q1-2014Q4.

The result for one-year-ahead forecasts, provides an α coefficient of -0.33, which is nonetheless not significantly different from zero in statistical terms at the usual confidence values (p-value: 0.14), while the β coefficient is estimated at +0.61, with a p-value of 0.0001. Thus, in net terms, according to this simplistic exercise, on average over the considered sample, and controlling for real GDP errors, inflation errors do not seem to explain errors in public revenue-to-GDP ratios. This said, when the sample is constrained to the 2008Q1-2014Q4 period, the estimated real GDP error coefficient is very similar (0.59, p-value 0.0008), but the inflation error coefficient α changes sign and becomes statistically significant at usual confidence values ($\alpha = 1.17$, p-value: 0.0185). This might be a sign that during the crisis and the low-inflation period, this situation might have been a limit to revenue-based fiscal consolidation efforts.

1.2.3. Quantitative assessment of inflation shocks on public finances

In the previous Section we have illustrated the influence of inflation and "inflation shocks" on certain public finance variables, from a general point of view. However, the nature of the "inflation shock" is crucial to assess the impact on public finances. In this regard, we will use the Quarterly Macroeconometric Model of Banco de España (MTBE, see Estrada et al., 2004., and Hurtado et al., 2014) to simulate the public finance effects of two different shocks that push prices down by one percentage point: an internal inflation shock (Spanish firms reduce their markups) and an external inflation shock (the price of oil in international markets goes down).

The MTBE is a large-scale macro-econometric model used for medium term macroeconomic forecasting of the Spanish economy, as well as for evaluating the staff projections and, as will be the case here, for performing scenario simulations: we change some exogenous variables (markups and oil prices) and see how endogenous variables react. The model is specified as a large set of error correction mechanism equations, and, especially in the short run, is mostly demand driven.

The main results of our simulations are presented in Table 1.2.1. In the simulation of an internal inflation shock, firms reduce their mark-ups, which makes HICP and the GDP deflator fall by approximately the same amount (the size of the simulation is calibrated so that HICP falls by exactly one percentage point on the first year). This has positive effects on GDP, through two channels: on one hand, with lower prices, households have a higher real disposable income, so they increase their consumption and housing investment; and on the other hand, as goods produced in Spain now have a lower price, exports grow. With higher demand, firms invest more and hire more workers, which further increases income for households and demand for firms, so second-round effects reinforce and expand the initial first-round positive effects on GDP.

Table 1.2.1.: **Impact of lower inflation on the main macroeconomic and public sector variables**
Cumulative level differences, %

	Internal inflation shock (mark-ups)			External inflation shock (oil price)		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
PRICES						
HICP	-1.0	-1.0	-0.9	-1.0	-1.0	-1.0
GDP deflator	-0.9	-0.8	-0.8	0.0	0.1	0.1
REAL VARIABLES						
GDP	0.2	0.4	0.4	0.2	0.5	0.6
Private consumption	0.2	0.5	0.6	0.4	0.9	1.2
Private productive investment	0.5	1.0	1.3	0.3	0.7	0.9
Housing investment	0.6	1.0	1.1	1.1	2.1	2.6
Exports	0.2	0.4	0.4	0.0	0.0	-0.1
Imports	0.4	0.8	0.9	0.4	0.9	1.2
NOMINAL PUBLIC SECTOR VARIABLES						
Total receipts	-0.4	-0.3	-0.2	0.0	0.3	0.5
Direct taxes to households	-0.6	-0.4	-0.3	0.3	0.7	1.0
Direct taxes to firms	-1.7	-1.1	-1.0	0.5	1.0	1.2
Social contributions	-0.1	-0.1	0.0	0.1	0.3	0.5
Indirect taxes	-0.7	-0.4	-0.4	-0.5	0.0	0.3
Total expenditures	0.0	0.0	0.0	0.0	-0.1	-0.1
Public consumption	0.0	0.0	0.0	0.0	0.0	0.0
Public investment	0.0	0.0	0.0	0.0	0.0	0.0
Interest payments	0.0	0.1	0.2	0.0	0.0	-0.2
Unemployment benefits	-0.3	-0.8	-1.1	-0.5	-1.2	-1.8
Other social transfers	0.0	0.0	0.0	0.0	0.0	0.0
Primary balance (% of GDP, difference)	-0.2	-0.1	-0.1	0.0	0.1	0.2
Balance (% of GDP, difference)	-0.2	-0.1	-0.1	0.0	0.2	0.2
Public debt (% of GDP, difference)	0.7	0.6	0.6	-0.2	-0.6	-1.0

Source: Authors' calculations

However, the total increase in real GDP is much less than 1%, so nominal GDP falls following this shock, and, because of this, nominal receipts of the public sector fall (the biggest impact is on direct taxes to firms, but direct taxes to households and indirect taxes also fall sharply in nominal terms).

On the expenditure side, there is a very moderate fall because the economic expansion reduces unemployment benefits, but all other expenditure items remain mostly unchanged⁽¹⁵⁾.

⁽¹⁵⁾ Pensions are kept constant because we impose the assumption that the indexation channel is shut down in these simulations, consistently with the results that will be presented in Section 1.2.4. Relieving this assumption and letting pensions react to inflation does not alter the main results of this exercise.

The net effect on the public sector balance is negative but very small (the deficit is slightly higher in the first year because revenues fall faster than expenditures, but even this effect dies out in the medium term). Nevertheless, even with a very small effect on the public deficit the debt-to-GDP ratio clearly worsens following this internal deflationary shock since the nominal GDP has fallen.

The simulation of an external inflation shock is also calibrated so that HICP falls by 1% in the first year (oil prices fall by 24%, from 77 to 58 euros per barrel), but in this case the effects on public-sector variables are completely different. For a start, in this case the direct effect on the GDP deflator is approximately zero: there is no internal production of oil, so the price of goods produced at home is not hit directly by the shock. Even the second-round effects on the GDP deflator are approximately zero with the estimated coefficients of MTBE (in fact, if anything, they are positive: the deflationary effect on wages and internal prices is estimated to be very small, and is dominated in the medium term by the –also not particularly big– inflationary effect of higher demand).

The competitiveness channel through which lower inflation improved GDP after a fall in mark-ups is almost non-existent in the case of oil prices, because this is an international shock that also affects our trading partners. The increase in GDP is due only to the higher real disposable income of households, who increase their consumption and housing investment after the shock.⁽¹⁶⁾ Firms face higher demand, so they invest more and hire more workers, generating second-round effects that are similar to the ones described for the previous simulation.

In this case nominal GDP clearly rises (real variables grow, the GDP deflator does not change), which makes nominal government receipts grow as well (mainly through direct taxes to firms, but also direct taxes to households and social contributions; indirect taxes initially fall, then restore their original level), whereas unemployment benefits again drive a very small fall in public sector expenditures. In sum, there is a slightly positive effect on the budget balance, and a sizeable fall in the debt-to-GDP ratio, because of the slightly lower deficit but even more importantly because of higher nominal GDP.

These two simulations highlight the importance of taking into account the sources of low inflation when assessing its impact over the public finances. We have chosen to show the effects of two shocks that generate an identical fall in the HICP but also a similar rise in GDP. Despite those similarities the effect on public finances turns out to be markedly different: they deteriorate if the low inflation comes from a fall in markups, but they improve if it comes from a fall in oil prices.

1.2.4. The effectiveness of the most recent pension reform in a low inflation regime

In this Section we explore the impact of changes in inflation assumptions in an accounting model of pension expenditure estimation along the lines of European Commission (2015), as done by Ramos (2014). A recent strand of pension reforms in Spain provide a natural framework to assess their effectiveness depending on the inflationary regime.

Spain is no exception in the gradual ageing of the population foreseen in the demographic projections available for most developed countries, with the corresponding pressure over pension systems. Indeed, in recent decades Spain has undergone a radical demographic transformation, characterised by a sharp fall in the birth rate, higher life expectancy, and a shift in net migration, which was highly positive in the years of the economic expansion (from 1997 to 2008) but has been negative since 2009 (see Ramos, 2014). Furthermore, since the Spanish pension system is pay-as-

⁽¹⁶⁾ This channel is actually stronger now: the positive effect on real GDP was smaller in the previous simulation because after the fall in mark-ups firms pass smaller profits on to households, which is not the case after the fall in oil prices.

you-go, the economic crisis has made evident the accumulation of imbalances, as the demographics-driven increase in pension expenditure was coupled with a sharp fall in the number of contributors.

1.2.4.1. The "revaluation index" of pensions

With a view to counteracting the impact of these demographic shifts, in recent years various pension reforms have been passed in Spain. For the purposes of this paper, the most relevant one is the reform enacted at the end of 2013, in particular the establishment of a new *revaluation index*. Under the later, pensions have been adjusted on a year-by-year basis according to the performance of variables pivotal to the Social Security system, such as revenue, expenditure and the number of pensions, replacing the former system, in force since 1997, which linked pensions to CPI inflation.⁽¹⁷⁾ The revaluation index is obtained from the budget constraint on the pension system, that is, from equating revenue to expenditure in year $t+1$, and decomposing expenditure into three components: revaluation, number of pensions and the substitution effect.

Specifically, the revaluation index works as follows⁽¹⁸⁾

$$RI_{t+1} = \bar{g}_{r,t+1} - \bar{g}_{p,t+1} - \bar{g}_{s,t+1} + \alpha \left[\frac{R_{t+1} - E_{t+1}}{E_{t+1}} \right] \quad (4)$$

Where RI_{t+1} is the revaluation index, i.e. the amount by which pensions grow between years t and $t+1$. The variables that come into play in the calculation, from left to right, are: the rate of change of the revenues of the Social Security System ($\bar{g}_{r,t+1}$), the rate of change of the number of pensions ($\bar{g}_{p,t+1}$), the substitution effect ($\bar{g}_{s,t+1}$)⁽¹⁹⁾ and a component that adjusts for imbalances that may arise between Social Security revenue (R) and expenditure (E). When the difference between revenue and expenditure is positive, this component increases the revaluation, while if it is negative, it reduces it. The imbalance between revenue and expenditure is multiplied by parameter α , which measures the speed at which the imbalances are corrected. The extant legislation stipulates that a value of α equal to 0.25 is to be used, which means that in each year 25% of the imbalance between revenue and expenditure is corrected.

Quite importantly, all these components of the right-hand-side of the formula are not included in as current year values, but via 11-year averages centered on $t+1$. This allows for smoothing of the year-to-year rates of revaluation and mitigates the effects of the business cycle.

In any case, the result of the formula just described does not yield automatically the revaluation of pensions in year $t+1$, as the law establishes both a floor and a ceiling, which will be crucial for the purposes of this paper. In particular, the revaluation cannot result in a pension increase, which is lower than 0.25% or higher than a rate equal to inflation plus 0.5%.

⁽¹⁷⁾ Quite importantly, the 2013 reform also regulates the so-called *sustainability factor*. From 2019, starting pensions will be automatically linked to the increase in life expectancy. For further details, see Ramos (2014).

⁽¹⁸⁾ See Ramos (2014) and De la Fuente and Domenech (2013) for additional details and references.

⁽¹⁹⁾ This is defined as the increase in the average pension in a year in the absence of any revaluation that year. That is to say, the increase in the average pension that comes about owing to the fact that the pensions of new pensioners are usually higher than the pensions of pensioners who die and abandon the system. In this way, the substitution effect depends on the number and amount of pensions of new pensioners relative to the number and amount of the pensions of pensioners exiting the system. It is estimated that the substitution effect would currently stand at around 1.0%. This component enters the formula with a negative sign, meaning that the revaluation index is smaller in order to counteract the upward pressure on expenditure due to the amount and number of new pensions.

1.2.4.2. Some simulations

The simulations are based on the latest Ageing Report as of 2015. Social security revenues and the demographic path are given, and the pension expenditure path, in turn, is determined by the above-described formula determining pension increases. The model is comprehensive enough to account for the main features of the social security system, from an accounting point of view. Agents' reaction to the policy path (reform) and the evolution of minimum pensions are not reflected in the exercise. The simulations are not to be considered as long-term forecasts, given dependence on exogenous assumptions and the uncertainty surrounding them, but rather as an illustration of how the revaluation formula works in different scenarios, particularly for inflation.

Table 1.2.2.: Pension expenditure scenarios (accounting simulations)

		2015	2016-2024	2025-2050	2050
REVALUATION INDEX (ageing scenario) ^(a)					
Pension expenditure ^(b)	% of GDP	11,99	11,24	11,54	12,17
Social Security revenues ^(c)	% of GDP	10,87	10,87	10,87	10,87
Social Security balance	% of GDP	-1,13	-0,38	-0,67	-1,30
Inflation rate	%	-0,47	1,74	2,00	2,00
Average index revaluation	%	0,25	0,45	0,31	0,25
Average pension / average wage ^(d)	ratio	57,10	52,87	39,96	32,10
Growth of number of pensions ^(c)	%	0,84	1,69	2,00	0,28
Growth of initial pension before sustainability factor	%	0,11	2,85	3,50	3,58
Sustainability factor ^(c)	factor	1,00	0,98	0,85	0,77
Growth of initial pension after sustainability factor ^(b)	%	0,11	2,15	2,72	2,90
REVALUATION INDEX (inflation 3.00% scenario)					
Pension expenditure ^(b)	% of GDP	11,99	11,18	11,01	11,13
Social Security balance	% of GDP	-1,13	-0,31	-0,15	-0,27
Inflation rate	%	-0,47	2,41	3,00	3,00
Average index revaluation	%	0,25	1,01	0,77	1,65
Average pension / average wage	ratio	57,10	52,55	38,34	29,28
REVALUATION INDEX (inflation 0.25% scenario)					
Pension expenditure ^(b)	% of GDP	11,99	11,58	14,01	16,13
Social Security balance	% of GDP	-1,13	-0,72	-3,14	-5,27
Inflation rate	%	-0,47	0,57	0,25	0,25
Average index revaluation	%	0,25	0,25	0,25	0,25
Average pension / average wage	ratio	57,10	54,49	48,26	42,89
REVALUATION 1% (ageing scenario) ^(a)					
Pension expenditure ^(b)	% of GDP	11,99	11,48	12,49	13,67
Social Security balance	% of GDP	-1,13	-0,61	-1,62	-2,81
Average revaluation of pensions	%	0,25	0,92	1,00	1,00
Average pension / average wage ^(d)	ratio	57,10	53,99	43,15	36,20
REVALUATION 2% (ageing scenario) ^(a)					
Pension expenditure ^(b)	% of GDP	11,99	11,87	14,28	16,37
Social Security balance	% of GDP	-1,13	-1,00	-3,41	-5,50
Average revaluation of pensions	%	0,25	1,81	2,00	2,00
Average pension / average wage ^(d)	ratio	57,10	55,88	49,26	43,53

(a) Demographic variables and Social Security revenues are taken as exogeneous. Projections rest mainly on 2015 Ageing Report assumptions. Pension expenditure evolves according to demographic projections and the revaluation of pensions. GDP and inflation are based on Budgetary Plan up to 2018.

(b) Including other Social Security expenditure.

(c) Invariant assumption across scenarios.

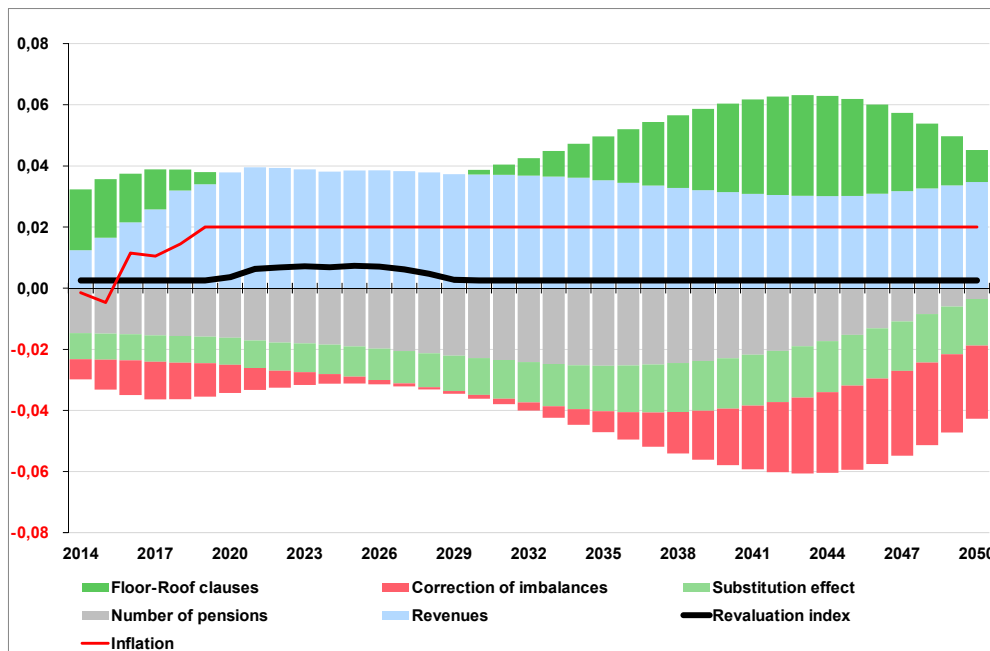
(d) Average wage grows 3.3% on average, according to 2015 Ageing Report.

Source: Authors' calculations

The main assumptions of the simulations are shown in Table 1.2.2., together with the main outcomes of the exercises. From 2015 revenues are set to the expected outturn of that year, namely 10.9% of GDP, while the rate of change of new pensions is linked to the rate of change of average wages. The number of pensions gains speed as of the decade of 2020 due to the retirement of baby boomers (Graphs 1.2.5a. and 1.2.5b.). Pension expenditure and the average pension are obtained endogenously.

With the basic assumptions outlined above, and under the *revaluation index*, pensions would grow with the floor over the simulation horizon (see Graph 1.2.5a.), although slightly above between 2020 and 2028. This is due to the fact that at the beginning of the simulation horizon the imbalance of the Social Security system inherited from the crisis dominates the formula. Then, in the twenties, the rate of growth of revenues is higher enough to compensate the increase in the number of pensions and to gradually correct the deficit. But then, as of the decade of the 2030, demographic pressures hit and the deficit widens again. Under this simulation, despite the fact that the inflation rate in the baseline AWG averages 1.7% over 2016-2024 and 2% as of 2025, pensions are set to grow most of the years at 0.25%. Given that in the model wages are assumed to grow in line with nominal productivity, the ratio of average pension to average wage falls from 0.57 in 2015 to 0.32 in 2050 (see Table 1.2.2.). Thus, the ratio of pension expenditure over GDP evolves from 12.0% in 2015 to 12.2% in 2050, increasing just 0.2 pp of GDP over that period, despite the adverse demographics.

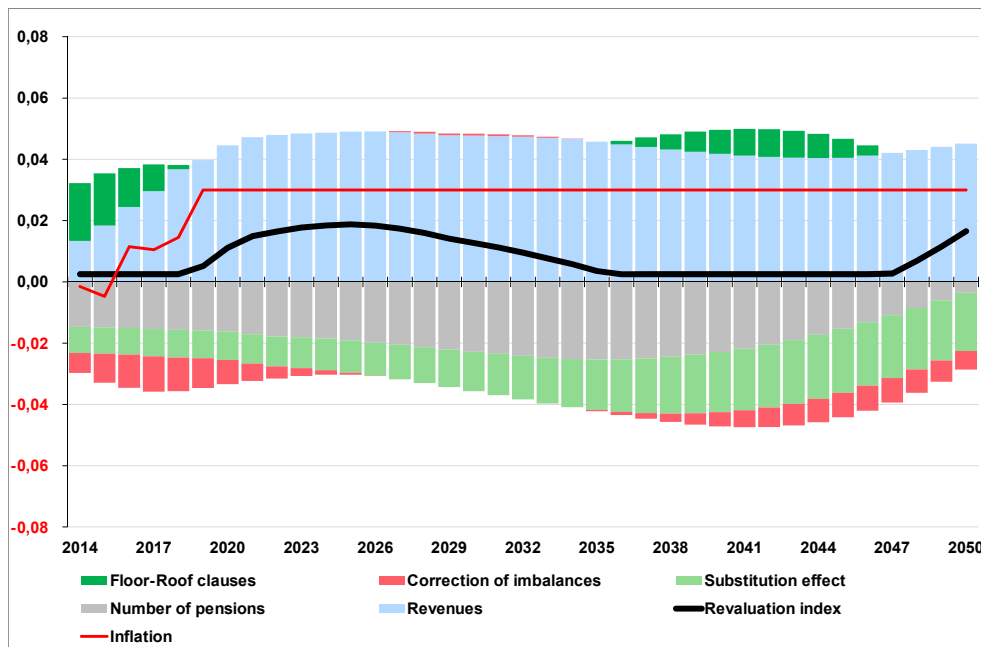
Graph 1.2.5a.: Pension revaluation and sustainability factor (ageing scenario)
(growth rate and percentage points)



Source: Authors' calculations

The importance of the inflation regime for the application of this revaluation-index formula is clear when comparing this baseline simulation with other two scenarios⁽²⁰⁾. First, an inflationary scenario where the inflation rate is supposed to increase steadily by 3%, affecting nominal variables but without an impact on real variables. In this case, Social Security revenues (linked to nominal GDP) allow for a revaluation of pensions close to 2% in the twenties and by 2050, while the substitution effect still pushes the revaluation index to the 0.25% floor in the middle of the simulation horizon (see Graph 1.2.5b.). Nevertheless, the ratio of the average pension to the average wage falls to 0.29 in 2050, while the ratio of expenditure to GDP is in 2050 11.1%, a level below the starting point of the simulation, 2015.

Graph 1.2.5b.: Pension revaluation and sustainability factor (Inflation 3% scenario)
(growth rate and percentage points)



Source: Authors' calculations

On the contrary, if the inflation rate is supposed to remain at 0.25%, the outcome is a smaller fall in the ratio of the average pension to the average wage, to 0.43 in 2050, as pensions do not lose purchasing power each year. The downside of this is that the ratio of pension expenditure increases significantly between 2015 and 2050, by 4.1 pp of GDP. This result makes evident that there is always a tradeoff between the ratio of the average pension to the average wage, on the one hand, and the ratio of pension expenditures to GDP, on the other.

These simulations show that, even with the same basic rule for calculating the revaluation of pensions, different inflation scenarios result in very different outcomes in terms of the purchasing power of pensions (ratio of average pension to average wage in 2050 ranging from 0.29 to 0.43, with

⁽²⁰⁾ In these alternative scenarios, real variables are the same as in the baseline scenario (same number of pensions, same number of employees, etc.). Nominal variables are changed in line with new prices (higher GDP, higher nominal SS revenue level, higher wages, etc.).

0.32 on the baseline scenario). In addition, these inflation scenarios also lead to significant differences in the total cost of the pension system, i.e. the ratio of pension expenditures to GDP in 2050 ranges from 11.1% to 16.1%, with 12.1% in the baseline scenario.

An alternative way to gauge the importance of inflation is to change the revaluation of pensions in the basic scenario. In this case, a floor to the revaluation of pensions of 1% per year would push up the ratio of pension expenditure to GDP to 13.7% by 2050 (12.2% in the basic scenario) while the ratio of the average pension to the average wage to fall to 0.36 (0.32 in the basic scenario). However, if the floor of the revaluation of pensions is supposed to be 2% per year, the ratio of pension expenditure to GDP would be 16.4% by 2050 (12.2% in the basic scenario) while the ratio of the average pension to the average wage would fall to 0.44 (0.32 in the basic scenario).

In any case, in all the scenarios presented here, the Social Security system would remain in deficit for the whole period. This deficit reaches -1.3 % of GDP in the baseline scenario, and -5.3% of GDP in the scenario where inflation is 0.25% per year.

In addition to the accounting simulations provided above, it is worth mentioning that some recent work by Sánchez (2014) also highlights the importance of the inflation regime on the outcomes of pension reforms: using an overlapping generations model to analyse the effectiveness of recent pension reforms in Spain, he concludes that persistently low levels of inflation could be as harmful for the success of the reform (in the long term) as poor immigration and productivity.

1.2.5. Concluding remarks

We empirically explore the influence of inflation on fiscal variables in the short-, medium- and long-run, for the case of the Spanish economy, in particular to draw policy lessons for the design of the pending process of rebalancing of fiscal accounts. Indeed, while Spanish public finances are in a correction path, still high government deficits and debt levels are registered by the different public administrations. In addition, the yields of a number of structural fiscal measures implemented are contingent on the future path of inflation, and the nature of inflation shocks/regimes. In this paper, we look at these issues through the lenses of: (i) the government budget constraint to assess the influence of inflation on changes in public debt; (ii) accounting decompositions of nominal revenue and expenditure items into their real and price parts; (iii) a large-scale macroeconomic model that contains a detailed fiscal policy block; (iv) a long-run accounting model on pension expenditure (along the lines of the works of the AWG).

Our main findings are as follows. First, we find that during the recent episode of fiscal consolidation, discretionary fiscal policy measures yielded less adjustment due to the situation of lower inflation. This applied to debt reduction strategies, both as regards government revenues and expenditures. In addition, public debt dynamics were significantly more adverse than in the higher-inflation episode of the second half of the 1990s when the stabilization of government debt was supported by favorable GDP and inflation dynamics. Second, despite the previous observations, we illustrate how the impact of low inflation on public finances depends crucially on the source of the inflation shock hitting the economy, with some external shocks (a fall in oil prices) presenting even a positive impact over public finances, while internal price shocks (a decrease in mark-ups) still have the potential of worsening public debt-to-GDP ratios. Finally, in our pension-accounting model we show how different inflation regimes crucially determine the effects of the major pension reform of 2013, measured by the long-term dynamics of the ratios of pension expenditure over GDP and average pension over average wage. In this sense, we find that, given the revaluation scheme in place since 2013, a regime of lower inflation would keep the average pension closer to the average wage, but would increase the cost of the pension system as a share of GDP, whereas a higher inflation regime

would assure sustainability by keeping the ratio of pension expenditure to GDP close to current levels but could lead to a potential problem of insufficiency of public pensions.

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1.2.6. Discussion by Werner Roeger(*)



Discussion of

Public finances and inflation: The case of Spain

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January 2016

The views expressed here are those of the authors and should not be attributed to the European Commission.

Summary of the paper



The paper is motivated by the currently low inflation in Spain and explores short, medium and long term consequences of inflation on the budget.

- 1) Government debt dynamics are more adverse in a low inflation environment.
- 2) The impact of inflation on budget depends on the source of the disinflation shock.
- 3) Pension reforms can be implemented more easily if inflation is not too low.

I agree largely with the principal findings of the paper.

(*) European Commission, DG ECFIN.

1) Low inflation and debt dynamics



Low inflation: A source or a symptom?

$$\frac{D_t}{Y_t} = (1 + i_t - \pi - g_t) \frac{D_{t-1}}{Y_{t-1}} + p_t + \frac{DDA_t}{Y_t} \quad (2)$$

And

$$i_t - \pi - g = r - g$$

What is important for the budget is the difference between the real interest rate and the growth rate of the economy.

Low inflation can be associated with $r-g$ small or large.



Case 1: **Low inf**, low r , high g => $r-g$ small

If high growth is generated by transitory positive supply shocks.

Case 2: **Low inf**, high r , low g => $r-g$ large

If high risk premium on domestic debt

And/or

Low expected future productivity growth is low.

Table: Spain: r-g (93-98) vs. (09-14)

	93-98	09-14
Inflation	3.6	1.4
Nom interest rate	8.5	5.1
Real interest rate	4.9	3.7
Growth	2.5	-1.3
r-g	2.4	5.0

The table shows that inflation differential between the two episodes does not seem to be the most important problem (since the real interest rate is similar in both episodes)

The difference appears to be r-g



Figure: Spain: Real interest rate and real growth rate



Consolidation affects inflation



Table: Reduction of government purchases by 1% of GDP

	2013	2014	2015	2016	2017
GDP_PCER	-0.65	-0.35	-0.13	-0.07	-0.06
EMPLOYMENT_PCER	-0.36	-0.16	-0.02	0.00	-0.01
CONSUMPTION_PCER	-0.07	0.37	0.75	0.92	0.96
INVESTMENT_PCER	-0.12	0.10	0.34	0.50	0.63
GOVERNMENT_PURCHASES_PCER	-5.34	-5.34	-5.34	-5.34	-5.34
EXPORT_PCER	0.38	0.64	0.67	0.63	0.60
IMPORT_PCER	-1.24	-1.10	-0.86	-0.71	-0.65
NOMINAL_WAGE_PCER	-0.86	-1.25	-1.03	-0.83	-0.75
GDP_DEFLATOR_PCER	-0.46	-0.75	-0.79	-0.75	-0.71
TOT_PCER	-0.35	-0.61	-0.65	-0.62	-0.59
REAL_INT_RATE_ER	0.46	0.09	-0.04	-0.05	-0.02
GOV_DEBT_GDP_ER	0.10	-0.69	-1.78	-2.93	-4.10
GOV_BAL_GDP_ER	0.68	0.89	1.09	1.22	1.30
GOV_EXP_GDP_ER	-0.58	-0.75	-0.87	-0.91	-0.91
GOV_REV_GDP_ER	0.05	0.07	0.09	0.10	0.11
CURRENT_ACC_GDP_ER	0.30	0.28	0.22	0.19	0.18

2) Budgetary impact depends on source of shock



The source of the disinflation shock is crucial for the fiscal impact.

The paper looks at two shocks:

Case 1: Price mark-up reduction. This shock slightly increases D/Y because real growth is lower than disinflation (negative nominal growth impact)

Case 2: Oil price reduction. GDP inflation zero + positive real growth => positive real growth => D/Y falls with disinflation.

Both cases show a typical positive supply shock.
 But:
 Low inflation in Spain is most likely the result of a negative demand shock.

Positive Supply Shock

markup	Year 1	Year 2	Year 3
Prices			
Price.level.Consumption	-0,42	-0,82	-0,99
Price.level.GDP	-0,56	-1,10	-1,33
Real variables			
GDP	-0,02	0,24	0,52
Consumption	-0,36	-0,36	-0,08
Investment	0,11	0,20	0,29
Investment.Construction	-0,59	-0,49	-0,27
Employment	-0,09	-0,02	0,06
Export	0,11	0,38	0,66
Import	-0,02	-0,11	-0,16
Public sector variables			
gov rev %GDP	0,02	0,08	0,16
gov exp %GDP	0,34	0,48	0,45
Government.purchases.nominal	0,00	0,00	0,00
Government.investment.nominal	0,00	0,00	0,00
Government.transfers.hi.h.real	0,00	0,00	0,00
interest payments %GDP	0,02	0,05	0,06
gov balance %GDP	-0,29	-0,39	-0,31
Gov Debt %GDP	0,53	1,22	1,47

Negative Demand Shock

deleveraging	Year 1	Year 2	Year 3
Prices			
Price.level.Consumption	-0,53	-0,89	-1,00
Price.level.GDP	-0,57	-1,05	-1,21
Real variables			
GDP	-0,93	-0,76	-0,39
Consumption	-2,55	-2,21	-1,63
Investment	-0,46	-0,82	-0,83
Investment.Construction	-3,39	-3,94	-3,52
Employment	-0,29	-0,19	-0,03
Export	0,08	0,27	0,48
Import	-0,30	-0,72	-0,98
Nominal public sector variables			
gov rev %GDP	-0,16	-0,18	-0,12
gov exp %GDP	0,86	0,96	0,82
Government.purchases.nominal	0,00	0,00	0,00
Government.investment.nominal	0,00	0,00	0,00
Government.transfers.hi.h.real	0,00	0,00	0,00
interest payments %GDP	0,06	0,11	0,16
gov balance %GDP	-1,00	-1,20	-1,07
Gov Debt %GDP	2,01	3,44	4,18

3) Pension reforms are easier with inflation

Long term effects of inflation/Pension scenarios

The pension scenarios show by how much pension benefit generosity must be reduced ($ben/w(2015)=0.6$; $ben/w(2050)=0.34$) in order to keep the pension system broadly balanced.

This is achieved by having pensions grow by 0.25% despite a return of inflation to 2%

The paper also shows that by allowing pensions to grow by 1% in the long run the social security balance would deteriorate to -3.6% of GDP in 2050 and by -6.7% of GDP if pensions would be allowed to grow with inflation.

Given, that there may be nominal downward rigidity for pension payments, relatively high inflation is obviously crucial for the political feasibility of pension reforms which aim at reducing the generosity of the pension system.

But this must be distinguished from direct economic effects of inflation. In fact OLG models used for demographic analysis usually do not take into account inflation effects, since money is simply a veil in these models (everything is expressed in real terms).

The paper cites an OLG analysis which takes into account inflation effects. However, inflation only plays a role insofar as it affects the ability to reduce the real value of pre-existing pensions.

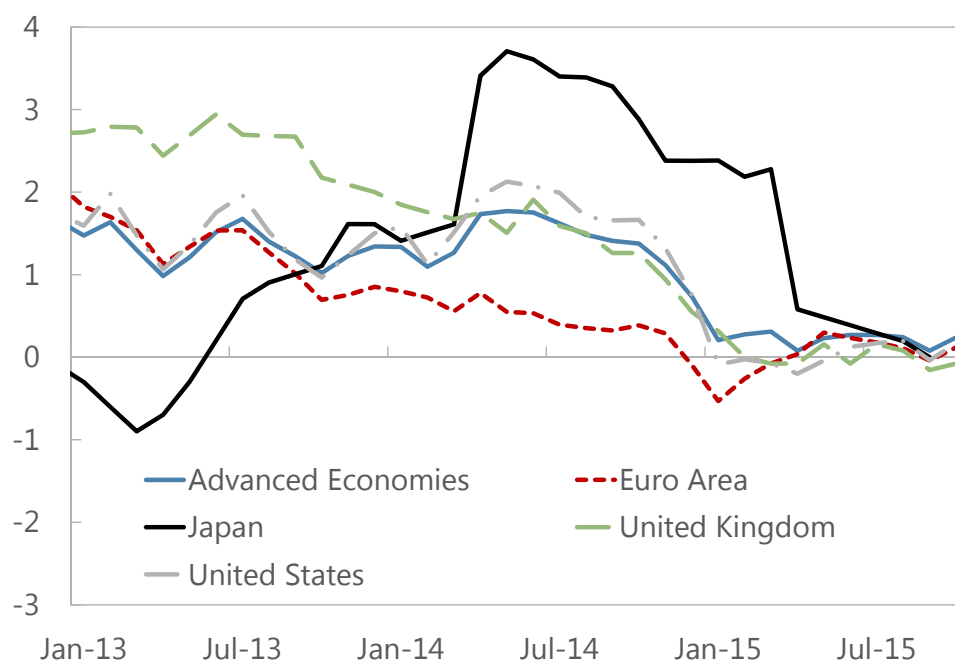
1.3. DEFLATION AND FISCAL AGGREGATES: SAILING WITH NO WIND PUBLIC FINANCES IN DEFLATION QUAGMIRE⁽²¹⁾

by Nicolas End(*), Sampawende Tapsoba(*), and Gilbert Terrier(*)

Disclaimer: The authors were invited by the Commission to present their ongoing work which was published as an IMF Working Paper. This paper is not the property of the European Commission and is therefore not published with the rest of the proceedings of the workshop. However, it is available online, following the link <https://www.imf.org/external/pubs/ft/wp/2015/wp15176.pdf>

In times of deflation or low inflation, fiscal consolidation turns more challenging, unless indexation mechanisms are fully effective. First, negative inflation leads to increases in debt ratios, as GDP deflators turn negative. Second, low or negative inflation rates adversely affect fiscal performance: tax collections are undermined and, with downward rigidities in expenditure, fiscal deficits tend to worsen. Evidence from 21 countries over a period of more than 150 years suggests that recessionary deflations are especially dangerous for fiscal sustainability. Moreover, with more elastic tax bases and automatic expenditure under asymmetric indexation mechanisms, fiscal accounts may be more at risk in modern times than in the past.

Graph 1.3.1.: Inflation in Advanced Economies (year-on-year, in %)



Source: IFTS

Note: Japan increased its sales tax rate in April 2014.

⁽²¹⁾ Based on N. End, S.J.-A. Tapsoba, G. Terrier, and R. Duplay (2015) "Deflation and Public Finances: Evidence from the Historical Records", *IMF Working Paper 15/176*.

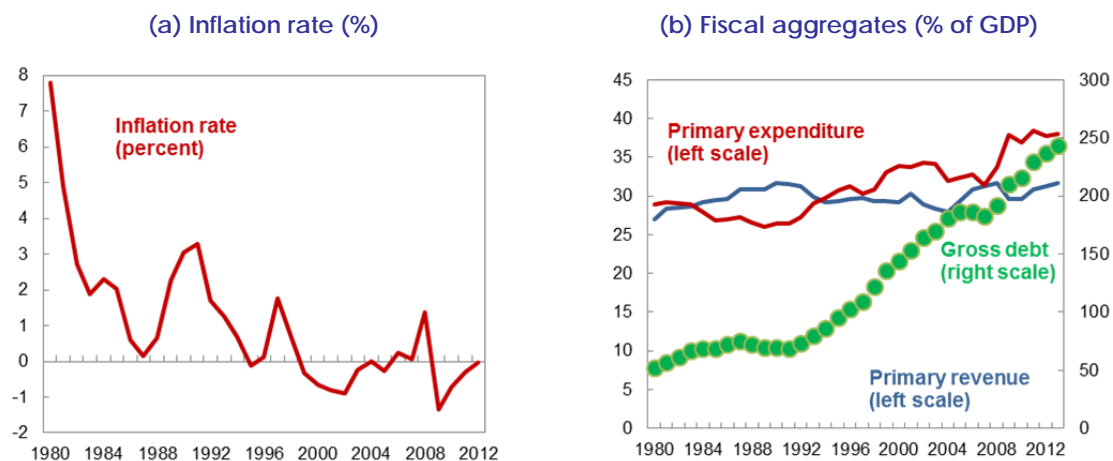
(*) International Monetary Fund.

1.3.1. Inflation below expectations: no wind inflating governments' sails?

For months, inflation has been running significantly below targets in several advanced economies, raising concerns over the risk of deflation. Fears of deflation are generally premised on the belief that it is accompanied with economic recession and debt-deflation traps, a mindset shaped during the Great Depression (Borio et al., 2015). We know from the prospect theory that economic agents' behavior is asymmetric — what about that of fiscal policymakers? Beyond its overarching impact on the economy, deflation has an immediate effect on fiscal aggregates. Policymakers often think in nominal terms and are reluctant to cut expenditure when falling prices nibble real tax receipts. Therefore, understanding the fiscal consequences of deflation is key for today's policymakers, especially at a time when governments steer towards strict deficit targets. The question has not received much attention in the literature, except from a survey of the European Commission country desks (EC, 2015).

Recent instances of deflation are scarce. In Japan —the example everyone has in mind when it comes to deflation, even though it was more a stagnating period for prices—, fiscal aggregates deteriorated during the so-called "lost decade" and, above all, debt ratios rose sharply (Graph 1.3.2b.). Over 1992–2013, public debt doubled and expenditure-to-GDP ratios rose, while the revenue ratio remained roughly stable. Yet, it would be difficult to distill any lesson from this experience: the effects of deflation interweaved with a demographic transition, discretionary tax measures and a shift in the tax base.

Graph 1.3.2.: Inflation and Fiscal aggregates in Japan (1980-2013)



Source: Authors' calculations

1.3.2. Deflation can turn the tide: asymmetries and composition effects

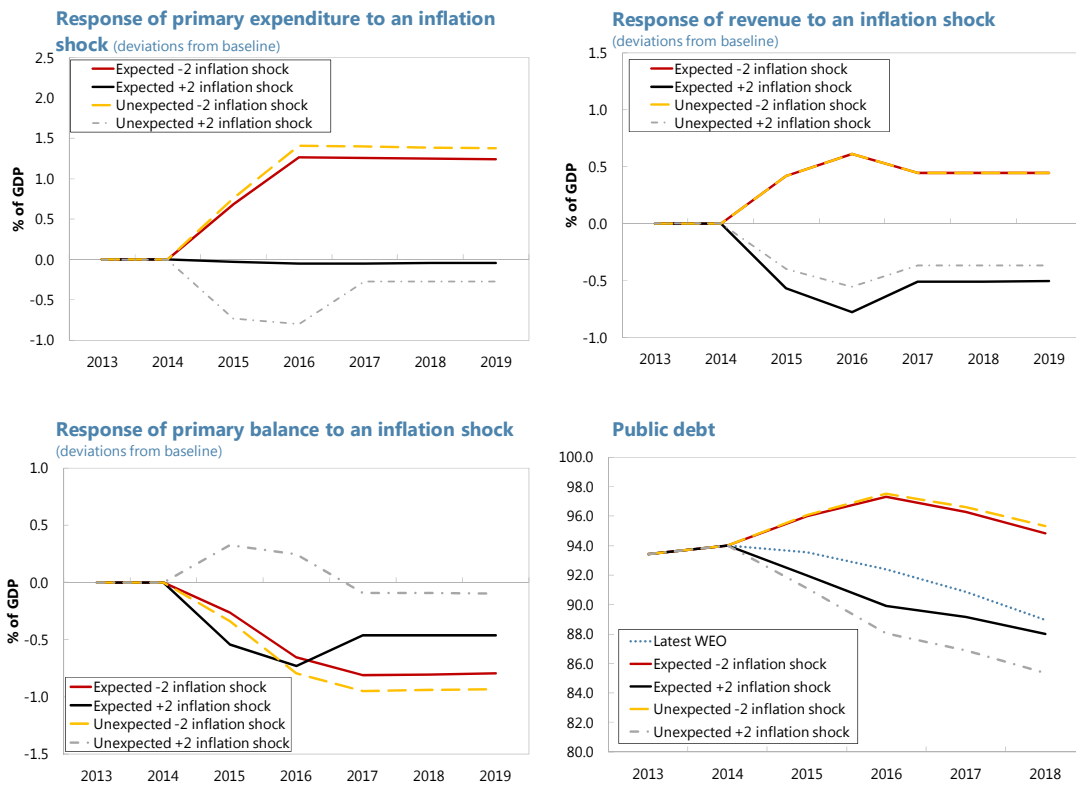
The intuition is simple and relates to structural asymmetry in the budgeting process between expenditure and revenue. Broadly speaking, budget laws define spending envelopes in nominal terms, and revenues by tax rates. As they follow tax bases, the latter adjust more elastically to price changes than spending. So the primary balance should deteriorate when a deflation or a deflationary shock occurs.⁽²²⁾ This effect on the primary balance compounds with a sluggish and imperfect

⁽²²⁾ A more precise discussion would account for tax progressivity, exemptions and the indexation of some tax provisions. Some revenues are less elastic to price swings (such as specific excises and nontax revenues), while, on the expenditure side, for some components being indexed, de jure or de facto, to prices.

downward response of the effective interest rate and a reduction in nominal GDP, pushing up the debt ratio.

To assess this intuition, we built a deficit-debt simulation model by decomposing the fiscal and debt aggregates into various components that respond differently to price changes, according to modern fiscal frameworks. Our model mimics three key features of today’s fiscal policymaking: price expectations, asymmetric indexation mechanisms, and nominal spending rules. In so doing, we capture two distinct features of the effect of deflation: (i) revenue and expenditure do not respond similarly—the former adjusts, while the latter is defined nominally; and (ii) unanticipated shocks are potentially more costly than expected ones. For the sake of illustration, the model is calibrated for the euro area, using the September 2014 World Economic Outlook forecasts (Graph 1.3.3.).

Graph 1.3.3.: Simulation Exercise



Source: Authors, WEO

A disinflationary surprise of 2 percentage points in two consecutive years relative to the baseline yields a deterioration in the primary balance of close to 1 percentage point over the 5-year horizon. This reflects primarily a permanent increase in primary expenditure ratios, while the positive effect on revenue ratios is mostly temporary. The impact on primary expenditure is bigger in absolute value than that associated with an inflationary shock, because political economy constraints challenge downwards indexation mechanisms. Even if governments anticipated deflation perfectly, they would likely be reluctant to adjust wages and social spending downwards.

Under our simulation, debt ratios would permanently increase over the five-year horizon by 6-7 percentage points of GDP relative to baseline scenario. The effect on debt is large for two reasons. First, the higher the initial debt levels, the more sensitive the debt ratio to price variations –

this is a stock effect, which is crucial for European countries. Second, the impact on the interest bill somewhat offsets the effect on the primary balance, but remains marginal— effective interest rates evolve sluggishly when a small share only of sovereign bonds is indexed.

These results, which assume no fiscal or monetary policy responses, highlight the magnitude of the strain deflation would exert on public finances, on top of potential consolidation needs.

1.3.3. Shipwrecks in the past: the good, the bad, and the ugly...

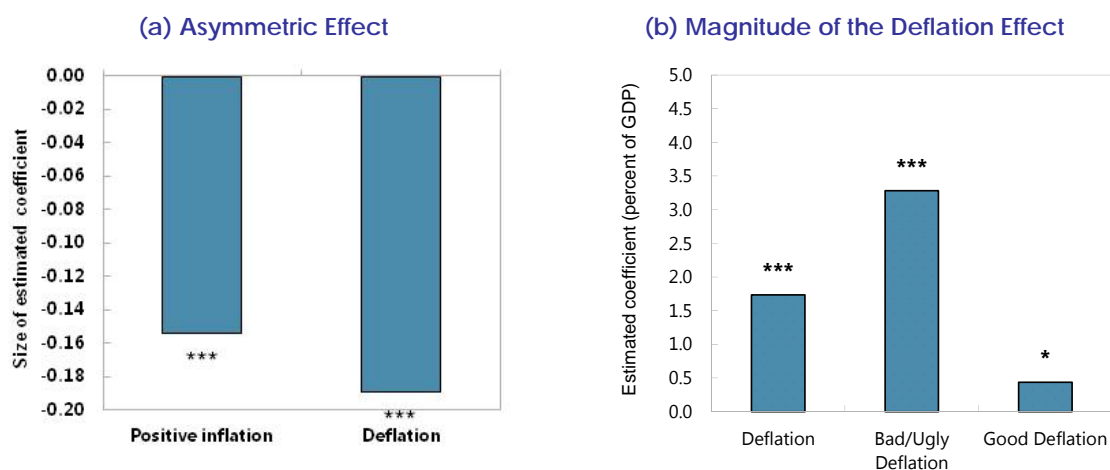
What does the past tell us? We compiled an original dataset starting from 1850 for 21 advanced economies. Accounting for potential persistence effects, we use two autoregressive models: one to assess potential asymmetries between positive and negative inflation and the other to capture the magnitude of the impact of deflation on fiscal aggregates. Admittedly, dealing with such long time series poses identification challenges that we addressed using the usual remedies (fixed effects, historical breaks, and instruments). The main issue comes from the inevitable entanglement of deflation impacts with discretionary policy measures in our observables.

Evidence suggest primarily that debt stocks rise significantly with negative inflation. On average during deflation times, debt-to-GDP ratios rise by 1.7 percentage points a year. The effect seems worse than the opposite of a positive inflation; one percent of positive inflation erodes debt ratios by 0.16 percentage point whereas negative inflation increases them by 0.19 point (Graph 1.3.4a.).

Not all deflations are alike though: the impact of deflation on public finances varies across growth regimes. With the exception of the Great Depression, deflation has generally not been associated with protracted recession (Atkeson and Kehoe, 2004). The existing literature distinguishes three broad categories of deflation (Borio and Filardo, 2004): (i) good deflations arise from positive supply shocks; (ii) bad deflations are associated with recessions and nominal rigidities; and (iii) ugly deflations represent periods of steeply declining prices combined with severe recessions. We find that the growth regime matters for the fiscal impact as well (Graph 1.3.4b.). Bad and ugly deflations have the strongest impact on debt. During such episodes, debt ratios rose by 3 percentage points of GDP a year on average. Conversely, during good deflations –that is, deflation with positive economic growth– debt-to-GDP ratios are less affected.

Graph 1.3.4.: Impact of Deflation on Debt Ratios

(*** and * indicate robust statistical significance at the 1 and 10% levels)

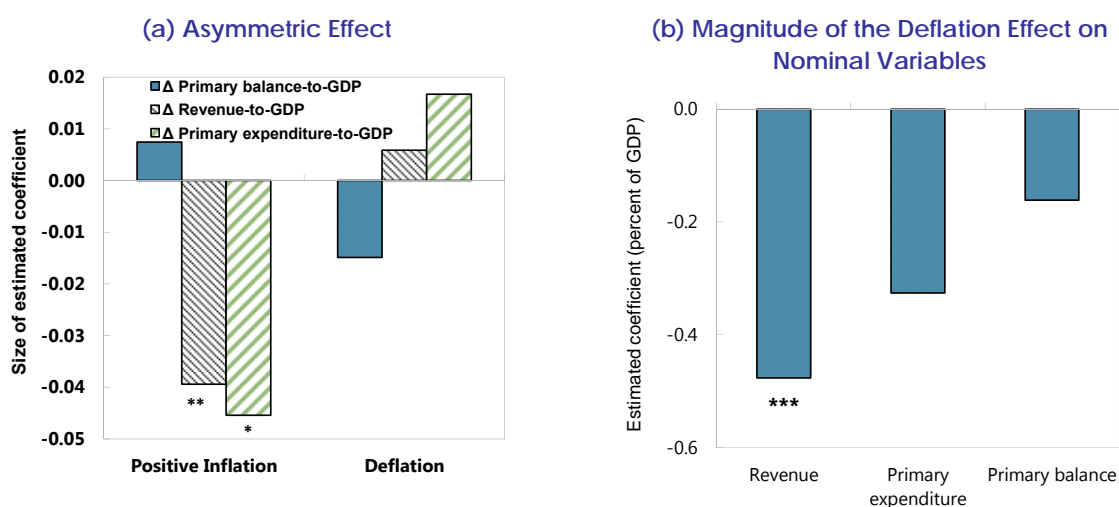


Source: Authors' calculations

In our sample, empirics confirm also the asymmetric response of expenditure and revenue we postulated, but the impact of deflation on the primary balance cannot be proven statistically significant (Graph 1.3.5a.). However, focusing on fiscal ratios can be misleading, as the effect on the denominator could mute that on the numerator. Neutralizing the denominator effect reveals that deflation is generally associated with both lower nominal revenues and lower nominal expenditures (Graph 1.3.5b.). When deflation coincides with growth, the primary balance tends to deteriorate on the back of declining revenues and rising expenditures. In recessionary deflation, expenditure cuts generally exceed revenue shortfalls—a risk looming around today’s European economies.

Graph 1.3.5.: Impacto of Deflation on Flow Variables

(*** and * indicate robust statistical significance at the 1 and 10% levels)



Source: Authors' calculations

1.3.4. Fiscal world has changed: from galleys to catamarans

As our dataset contains few episodes of deflation in modern times, we form the view that our findings may not reflect well the present risks of deflation. Prior to World War II, governments still had limited tools for intervening in the economy. Their tax systems relied above all on excises and customs tariffs and did not effectively reflect changes in nominal GDP. Apart from war spending and reparations, their expenditure were essentially discretionary and could be downsized easily whenever revenues scored below expectations (Webber and Wildavsky, 1986). In fact, Treasury bonds were mostly design to finance specific expenditure and the cash constraint drove most of the time fiscal policy (Sargent and Hall, 2015). This old form of government, based on a "tax and spend" approach, was relatively immune to deflation.

Fiscal frameworks in modern times are paradoxically more vulnerable to deflation—in part because of the composition of taxes and expenditure. Sophisticated tax regimes capture the variations of key macroeconomic parameters more directly (than, e.g., customs tariffs), part of expenditure is *de jure* or *de facto* committed beyond annual budgets, and even though a large share of spending is subject to indexation mechanism, downward indexation may prove impossible to implement because of political constraints. Besides, seigniorage revenue is smaller in modern monetary frameworks, and interest rate adjustment is limited by the zero lower bound.

1.3.5. Putting the pieces together: shall governments row towards fiscal targets?

Lessons on the risks of deflation from theoretical and empirical examinations can be drawn for the current state of the global economy. Slipping into deflation could contribute to undoing painfully undertaken consolidation efforts and, thus, threaten fiscal sustainability. Even low inflation rates could be a threat, given that CPIs generally overestimate inflation. With debt ratios already elevated, a deflationary spiral could propel debt ratios into unsustainable zones. Yet, governments may find it difficult to act against deflation, especially at the beginning of such episodes or when deflation is low, as the political cost of reducing the nominal face value of civil service wages or entitlements programs can, at least initially, appear too high to bear.

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1.3.6. Discussion by Martin Larch(*)





Discussion of
***Deflation and Public Finances:
Evidence from the Historical Records***

N. End, S. J.-A. Tapsoba, G. Terrier, R. Duplay

Martin Larch
Head of Unit for the Economies
of Ireland, Lithuania and Poland
DG Economic and Financial Affairs

"Fiscal Policy after the crisis"
ECFIN Workshop
Brussels, 19 January 2016



Overview

- *What does the paper do?*
- *What are the results?*



(*) European Commission, DG ECFIN.



What does the paper do?

- *Descriptive analysis of historical records*
- *Regression analysis with unbalanced panel:*
 - 21 developed countries;
 - from as early as 1851 (pre-unification Germany, Italy?)
 - Regression analysis explores differences across
 - Inflation and deflation episodes
 - Expansionary versus Recessionary Deflation episodes
 - Sub periods
 - Channels: denominator versus nominator of debt-GDP-ratio
- *Simulation exercise with simplified model*
 - Assumptions about how various budgetary components (revenue and expenditure) react to de/inflation shocks; anticipated versus surprise.

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What are the results?

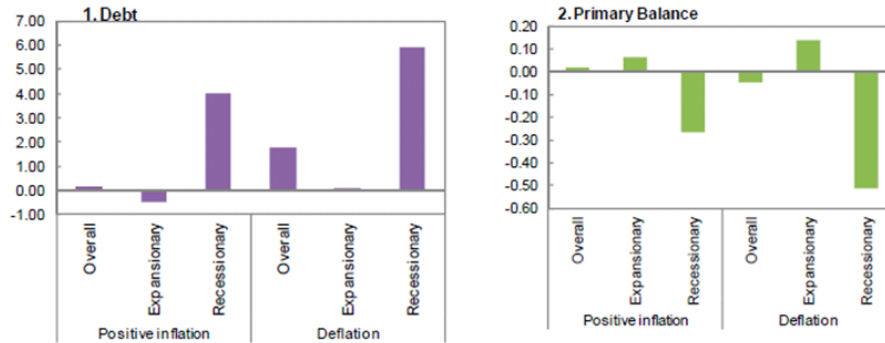
Descriptive Analysis

- Confirms result of 'fiscal reaction function' literature as a by-product:
Asymmetric debt dynamics across cycle for both inflation and deflation (increase during recessions much stronger than reduction during expansions); mainly on account of primary expenditure which also tends to increase (in % of GDP?) during expansions.

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Figure 1. Change in Fiscal Aggregates and Inflation Regimes



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What are the results?

Regression analysis: sub-periods

- Effect of deflation higher in 1929-34
 - Plausible at first sight
 - Are estimated coefficients across sub-periods significantly different?
 - How can non-linearity be explained?
 - What is permanent deflation shock? (footnote 29)
- Effect of growth surprisingly stable across sub-periods at around 0.45.
 - Why? Debt ratios have been growing and should - ceteris paribus - have amplified effect of growth.
- Statistical properties of estimates in sub-periods:
 - Is error term stationary for all sub-period including those in which we have seen sharp increases in debt?
- Sign of deflation coefficient?
 - Reported as negative in Table 1.

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What are the results?

Regression analysis: Deflation and primary balance

- Asymmetry across price cycle:
 - absolute value of deflation coefficient larger than the one of inflation (0.015 versus 0.007).
- Growth and inflation effect on revenue ratio slightly negative:
 - fiscal policy is distributing growth dividend or regressive tax systems? Probably both.
- Close to inertia of revenue and expenditure ratio in face of deflation:
 - Regressive taxes or leaning against the wind? Probably both.

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What are the results?

Regression analysis: Different degrees of inflation

- Low inflation produces no significant effect on debt and primary balance
 - Annual inflation between 0-2% proxy for no or minor inflation surprises. Plans are realised.
- High inflation and deflation do have significant effect on debt

Deflation and budgetary variables in levels

- Effect on primary expenditure increases over time:
 - Reflection of the historical increase in size of government? In post WWII period coefficient close to 0.4
- Are signs and size of reported coefficients for deflation correct? (Table 7)
 - Should deflation coefficients of revenues be negative?
 - Again: coefficients for revenues surprisingly large

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What are the results?

Lessons for Policy makers

- Tricky to derive strong conclusions from regression analysis> Most importantly, difficult to disentangle effects of economic environment from effects of discretionary fiscal policy decision.
- Did you look at profile of regression residuals? It could still include some interesting pieces of information.
- Stronger effect of deflation in recent times result of larger size of government.
- Interaction between fiscal rules and budgetary sensitivity? Budget more reactive to business cycle/price developments?

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What are the results?

Model simulation

- Assumes downward rigidity of government wages:
 - during last crisis several EU governments adjusted wages downward either through negotiations or as a result of indexation
- Assumes relatively strong effects of deflation on social contributions
 - Average contemporaneous effect to negative inflation surprises in EU in 2014 at around 0.6/0.5 rather than 0.9.
- Assumes relatively strong effects of deflation on social expenditure
 - Average contemporaneous effect to negative inflation surprises in EU in 2014 at around 0.1/0.2 rather than 0.3.

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Conclusions

- *Thorough attempt to extract regularities from data covering more than one and a half centuries.*
- *Basic priors of debt dynamics confirmed with specifics across sub-periods and cycle.*
- *Gauge of deflation effects with symplified model:
Sensitivity is large if shock not anticipated.*

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Thank you

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2. SESSION II: FISCAL POLICY AFTER THE CRISIS

2.1. OPTIMAL TAX SMOOTHING WHEN DEBT IS SUBJECT TO ASYMMETRIC SHOCKS

by *Julio Escolano*(*) and *Vitor Gaspar*(*)

Disclaimer: The authors were invited by the Commission to present their ongoing work which will be published by the authors upon a successful internal review and vetting process within the IMF. This paper is not the property of the European Commission and is therefore not published with the rest of the proceedings of the workshop.

The surge of the public debt-to-GDP ratio in advanced economies following the 2008 global financial crisis was unprecedented within the post-WWII period—but not from a longer-term historical standpoint. For more than two centuries, the debt ratios of the largest economies of the time (the United States and the United Kingdom) show rare but recurrent large surges due to wars, financial crises and economic downturns, followed by gradual but persistent declines over long periods. We show that this policy of gradual debt ratio reduction in normal times is optimal in the presence of debt shocks with a skewed distribution –as we argue is the case– if the government seeks to smooth taxes inter-temporally and minimize the present value of dead-weight loss.

(*) International Monetary Fund, Fiscal department.

The setup

$$\text{Min}_{\tau_t} E_0 \sum_{t=0}^{\infty} \beta^t \tau_t^2$$

such that

$$d_{t+1} = \beta^{-1} d_t - \tau_t + g + \varepsilon_{t+1}$$

d_0, g given

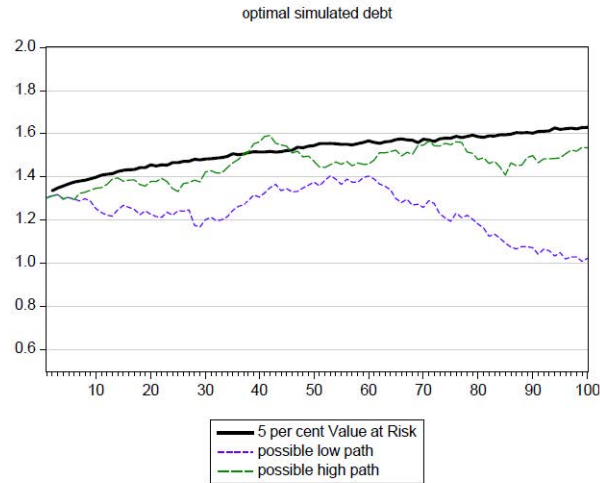
$$\lim_{t \rightarrow \infty} \beta^t d_t = 0 \text{ almost surely}$$

$$\beta^{-1} = 1 + \lambda = \frac{1+i}{1+\gamma}$$

The setup

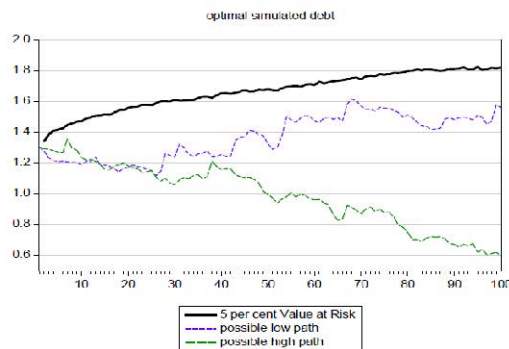
- tax smoothing taking into account the transversality condition (there debt can grow but "slowly")
- stochastic discount factor function of real growth
- debt shocks (most naturally interpreted as shock to government expenditure, but not necessarily so)

VaR with normal shocks



VaR with skewed shocks

Same calibration as before but additional skewed shock is added such that in each period there is a five per cent probability of a shock of 10 per cent to the debt GDP and a 95 per cent probability of a shock of -0.005



Two issues

- Is the "optimal" policy feasible in practice ?
- Further Investigation on the nature of the shocks
 - are they persistent ?
 - are they policy related ?
 - shocks to growth, to the cost of financing the debt, or to slow moving variables such as demographics might have different impact.

2.2. FISCAL CONSOLIDATION AND INEQUALITY: A DESCRIPTIVE ANALYSIS

by Tim Buyse()*

2.2.1. Introduction

Most OECD-countries face important social and economic challenges: per capita GDP growth is still very modest, unemployment remains persistent and income inequality and perceived poverty have also increased. Moreover, high budget deficits and public debts have urged many countries to pursue fiscal tightening and resort to programs of fiscal adjustment.

Many countries have gained experience with fiscal consolidation programmes in the past two or three decades. Analysis of the determinants of the success or failure of fiscal consolidation has also been high on the agenda of many researchers since seminal work by Giavazzi and Pagano (1990) and Alesina and Perotti (1995). The range of existing studies is extremely wide. Whereas some studies focus on individual countries or fiscal episodes (e.g. Giavazzi and Pagano, 1990; Perotti, 2011), most studies have a cross-country or panel setup. As dependent variable, a very large number of studies try to explain the probability of success in debt or deficit reduction (e.g. McDermott and Wescott, 1996; Alesina and Ardagna, 1998; Ardagna, 2004; Guichard et al., 2007; Schaltegger and Feld, 2009; Tagkalakis, 2009; Afonso and Jalles, 2012; Larch and Turrini, 2011). Others focus on the evolution of economic growth, private consumption, or private investment during and after consolidation periods (e.g. Giavazzi and Pagano, 1996; Hjelm, 2002; Alesina et al., 2002; Ardagna, 2004; IMF, 2010a; Alesina and Ardagna, 2012).

Explanatory variables may relate narrowly to the characteristics of the consolidation programme, e.g. its composition or size (see e.g. Alesina and Perotti, 1995, 1996; McDermott and Wescott, 1996, and Ardagna, 2004, among many others), the economic context within which consolidation takes place (e.g. McDermott and Wescott, 1996; von Hagen et al., 2002), or the institutional environment within which it takes place. As to institutions, some studies focus on fiscal institutions (e.g. Guichard et al., 2007), others on labour and product market institutions (Tagkalakis, 2009; Alesina and Ardagna, 2012), still others on the ideological orientation of government or the number of political parties in government (e.g. Alesina and Perotti, 1995; Ardagna, 2004; Tavares, 2004). In a recent study, Larch and Turrini (2011) pay attention to all these institutions, although they do not introduce them into their empirical model simultaneously.

The focus of existing studies is mostly on real output and growth effects as these are crucial for the success of consolidation. A lot of research has been done on the necessity and ideal composition of fiscal consolidation policies. One hypothesis that has received particular attention is that spending-based fiscal consolidation leads to better (less negative) output effects than tax-based consolidations. Some authors even find that spending-based consolidations have the highest probability to bring down the public debt ratio because it induces expansionary output effects, also in the short-run (Alesina and Perotti, 1996 and Alesina and Ardagna, 2012). Others are more pessimistic and expect spending cuts to cause short-run output losses (e.g. Perotti, 2011). With respect to public employment, Heylen et al. (2013) find that public wage bill cuts do not contribute to lower public debt ratios when public sector efficiency is high.

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We thank Christian Kastrop and the organizers and participants of the DG ECFIN workshop on "Fiscal policy after the crisis" for useful suggestions and comments.

Recently, the causes of income inequality have also attracted considerable (and renewed) attention from academics. According to the literature, many determinants can help explain observed trends in income inequality: globalization and integration of the world-economy, skill-based technological change, increasing employment in the tertiary sector, institutions and regulatory changes in product and labour markets, changes in the tax law... Disentangling the various channels of influence is, however, very difficult. Fiscal policy is known to be one of these determinants. Most studies in this context focus on how changes in certain categories of taxes or expenditures influence income inequality. (We mention among others Immervol and Richardson, 2011 and Afonso, Schuknecht and Tanzi, 2010). As to poverty, the literature has observed various micro and macro determinants. Factors such as educational attainment, age, employment status, family structure, generosity of social benefits (and especially of family benefits) and pension generosity are proved to have a significant negative effect on the odds of poverty. Macro factors, such as the regional unemployment rate and GDP, may also affect the individual at-risk-of- poverty status.

In the remainder of this paper, we focus on one possible determinant of inequality: the impact of prolonged periods of fiscal consolidation.

2.2.2. The distributional consequences of fiscal adjustments

The relationship between periods of fiscal tightening on the one hand and poverty and income inequality on the other, has only recently received increasing attention. An important gap remains regarding our understanding of the effects of fiscal adjustments on income (re)distribution.

Rawdanowicz et al. (2013, their Box 2) present modest empirical evidence on the impact of consolidation on equity by comparing the evolution of income inequality and poverty during the ten largest and most protracted past consolidation episodes in OECD countries. The authors observe that in about half of the analyzed cases, the GINI index for disposable income increased, potentially reflecting both increasing dispersion of market income and less redistribution of taxes and transfers. In the other half of the episodes, the net GINI index was unchanged or even declined. Agnello and Sousa (2014) analyze a panel of 18 industrialized countries and observe that inequality generally increases during periods of fiscal consolidation. This seems to be especially the case for periods driven by spending cuts, whereas tax hikes seem to have a redistributing effect. The authors also find that the size of the fiscal consolidation program has an impact on income inequality. In particular, when consolidation plans represent a small share of GDP, the income gap widens, suggesting that the burden associated with the effort affects disproportionately households at the bottom of the income distribution. By contrast, Ball et al. (2013) find that both expenditure and taxed-based fiscal consolidations at the national level have typically raised inequality for a panel of OECD countries, even if the distributional effects of spending-based adjustments tends to be larger relative to tax-based adjustments. These conclusions are largely confirmed for a broader panel of countries that also includes emerging markets, in a study by Woo et al. (2013).

Building on our previous work in Heylen et al. (2013), we analyze in this paper the relationship between the composition and design of fiscal consolidation periods on the one hand and income inequality on the other. As such, our paper is strongly related to the aforementioned contributions of Agnello and Sousa (2014), Ball et al. (2013) and Woo et al. (2013) but differs in some important respects. One crucial difference is that previous studies on this topic either use dummy variables to capture (the start) of a consolidation episode (Agnello and Sousa, 2014; Ball et al., 2013) or perform their analysis in a panel dataset, thereby neglecting the fact that subsequent years of fiscal tightening may belong to the same consolidation program (Woo et al., 2013). In this study, as in Heylen et al. (2013), we perform an analysis of fiscal adjustment episodes.

The descriptive analysis we perform in this paper gives only a first insight in the possible effects fiscal adjustments may have on income inequality. Based on our findings, we propose several possible avenues for future research that may advance the analysis and that we will perform in the near future.

2.2.3. Fiscal consolidation periods in the OECD, 1981-2012

The fiscal consolidation literature commonly determines consolidation and expansion periods using a criterion based on swings in the cyclically adjusted primary balance in percent of GDP (further *CAPB*). In a recent study, IMF (2010a) criticizes this method. Although the *CAPB* corrects for interest expenditures and business cycle fluctuations, it may sometimes give wrong signals about actual policy changes. Periods in which no specific consolidation measures were taken, were sometimes classified by researchers as consolidations. Also, periods with a deteriorating *CAPB* despite severe consolidation measures were sometimes not selected (IMF, 2010a). An important element is the influence of one-off budgetary measures. When one-off measures are taken, they may typically imply a temporary improvement of the reported *CAPB*, followed by a subsequent deterioration when their effect disappears. From the reported *CAPB*, one might erroneously conclude that a fiscal consolidation year was followed by an expansion year, whereas in reality there was no deliberate policy at all. A second problem is that traditional cyclical adjustment methods may sometimes suffer from measurement errors. They may for example fail to remove swings in tax revenue that are associated with (cyclically affected) asset price movements. Instead of the *CAPB* as a selection variable for consolidation and expansion periods, we use the underlying cyclically adjusted primary balance in percent of potential GDP (*CAPB_u*). The latter corrects the *CAPB* for one-off transactions and budgetary measures. *CAPB_u* data are published by the OECD; annual data are available since 1980.

On the basis of these data, we define our periods of fiscal consolidation. Each episode is a period of flexible duration in which the *CAPB_u* consistently moves in the same direction. Following Heylen and Everaert (2000) and Heylen *et al.* (2013), a consolidation period is a period of at least two consecutive years when the *CAPB_u* improves by at least 2 percentage points. Besides the requirement that the *CAPB_u* improves in each single year of the consolidation period, there should be an improvement by at least 0.25 percentage points in the first year of the consolidation period and at least 0.10 percentage points in the final year. With the latter conditions, we hope to exclude years of mere stabilization. Applying these criteria to 21 OECD countries in 1981-2008 yields 45 consolidations. Table 2.2.1. shows these different periods and their changes in the *CAPB_u*. We come back to this in the next section.

The definition of fiscal episodes is not uniform in the literature. Heylen and Everaert (2000), Guichard *et al.* (2007) and recently Alesina and Ardagna (2012) also define episodes of flexible duration. Most others, however, specify periods of a fixed number of one or two, and sometimes three years during which the change of the *CAPB* exceeds a chosen number (e.g. Alesina and Perotti, 1995; Alesina and Ardagna, 1998; von Hagen *et al.*, 2002; Tavares, 2004; Larch and Turrini, 2011).

Furthermore, it is not common to use the *CAPB_u* as a selection criterion to define fiscal episodes. In our previous study in Heylen *et al.* (2013) we thoroughly checked if this variable is indeed more reliable than the *CAPB*. We have therefore compared our selection of periods with the ones found by the IMF. The IMF (2010a) uses a narrative action-based approach to select fiscal adjustments. The authors emphasize five striking years which the commonly used *CAPB*-method incorrectly classifies as consolidations. Moreover, they point out five effective years of consolidation which are not classified as such. Nine of these ten years relate to 1981–2008. We report the details from our comparison in Heylen *et al.* (2011). We concluded that with the exception of only one case (Finland

1992), the change in the $CAPB_u$ gave the same signal as the IMF narrative approach. The data that one obtains to evaluate policy using $\Delta CAPB_u$ are in general much closer to the action-based indicator from the IMF than the data obtained when considering $\Delta CAPB$.

An important advantage of our flexible duration approach is that it allows to study homogeneous episodes as well-defined cases. Each episode ends with a change in policy. An important drawback of our approach of clearly defining periods of fiscal adjustment, in contrast to panel data studies, is the small number of observations. We are therefore limited in the type of statistical analysis to use. Therefore, in this paper, we perform a straightforward data-analysis and focus on correlations to make inference about the relationship between fiscal adjustment and inequality. In the near future, we will extend our analysis to the complete history of fiscal episodes in the set of OECD countries that we consider (i.e. also including periods of fiscal expansion or "neutral" periods as in Heylen *et al.*, 2013). An increase in the number of observations may then allow us to use more advanced and robust econometric techniques.

2.2.4. Data and methodology

2.2.4.1. A measure of inequality

As a measure for income inequality, we use the *GINI*-coefficients before and after redistribution (market resp. net). Data for the *GINI*-coefficient comes from the Standardized World Income Inequality Database (SWIID). Poverty rates that we use in this paper are gathered by *gini-research.org* (funded by the 7th European Union Framework Program for Research and Innovation). We use this dataset due to its extensiveness.

Table 2.2.1. shows the 45 consolidation periods we have identified in our set of 22 OECD countries since 1981. All countries we consider have experienced one or more adjustment periods since 1981. Some countries more than others. Belgium or Italy, for instance, had 3 distinct periods of fiscal consolidation. Note that we are not able to take into account the most recent adjustments that are observed in many (European) countries following the most recent economic crisis.⁽²³⁾ Overall, the average increase in the underlying cyclically-adjusted primary balance in the periods is about 4.15 % of GDP. Note that, by our definition, the increase is always more than 2% of GDP. The average duration of a consolidation period is around 3.5 years.

Table 2.2.1. also shows the evolution of income inequality during each period (both before (*market*) and after (*net*) redistribution). The change in the *GINI*-coefficient is calculated as the observed *GINI*-coefficient in the year after the consolidation period minus the *GINI*-coefficient at the start of the period.⁽²⁴⁾ On average, the market *GINI*-coefficient increases by about 1.14 %-points after a period of consolidation, whereas the net-coefficient increases by about 0.72 %-points. In the remainder of this paper, we will investigate whether this observed increase in income inequality during and after periods of fiscal adjustment is economically relevant and what might be its determinants.

⁽²³⁾ However, when we extend our analysis in the future, we hope to do so.

⁽²⁴⁾ Note that we have also calculated this change as the difference between the *GINI*-coefficient *two* years after the end year minus the *GINI*-coefficient at the start. This did not change our results.

Table 2.2.1.: Fiscal consolidation periods in the OECD: 1981-2008

	Period	$\Delta CAPBu$	$\Delta GINI_n$	$\Delta GINI_m$		Period	$\Delta CAPBu$	$\Delta GINI_n$	$\Delta GINI_m$
Australia	1994-1998	3,98	4,36	9,66	Japan	1981-1985	3,72	3,79	0,69
	2002-2003	2,19	-1,22	-2,14		2005-2008	3,09	0,82	-0,66
Austria	1984-1985	2,32	-2,35	0,50	Luxembourg	2005-2007	2,34	0,55	0,89
	1996-1997	3,71	-1,42	-0,43	Netherlands	1981-1983	3,11	0,25	1,18
Belgium	1982-1987	9,47	-0,90	-1,52	New Zealand	2004-2005	2,43	0,70	0,57
	1993-1994	2,62	4,44	1,57		1992-1994	4,18	1,19	3,25
Canada	1996-1998	2,23	0,23	0,67	Norway	1993-1997	5,84	-0,14	0,02
	1986-1988	3,71	-1,09	-0,07	1999-2000	2,98	0,40	0,70	
Czech Republic	1993-1997	7,43	2,98	3,78	2004-2007	3,59	-0,19	1,25	
	2010-2012	6,06	-0,71	-1,18	Portugal	1982-1984	7,37	-4,18	-4,15
Denmark	1983-1986	10,50	3,35	5,20	2006-2007	2,61	-1,85	0,77	
	1997-1999	2,23	-0,25	0,73	Spain	1992-1999	5,96	2,21	4,21
Finland	2003-2005	3,75	2,86	3,45	Sweden	1981-1984	4,12	-1,16	-3,48
	1993-1996	5,10	2,08	5,07	1995-2000	8,43	2,00	-2,95	
France	1994-1999	3,64	-1,09	0,86	2004-2005	2,15	1,54	3,81	
Germany	2003-2007	2,70	0,97	1,37	Switzerland	1998-2000	2,76	1,24	4,69
Greece	1998-1999	2,67	-2,21	-1,96	2005-2008	2,45	3,44	4,12	
Hungary	2007-2009	7,98	-0,94	-4,31	UK	1981-1982	2,72	0,63	1,59
Iceland	1995-1997	3,12	1,73	2,33	2010-2011	2,95	-0,89	-1,01	
	2003-2006	6,17	3,68	1,92	US	1993-1998	4,13	2,73	1,69
Italy	1992-1994	2,54	0,26	0,06					
	2003-2004	2,75	-0,02	2,90					
	1982-1983	4,37	0,12	-0,13					
	1990-1993	5,98	3,04	4,33					
	1995-1997	2,52	1,31	1,25	Average	3,5 years	+4,15	+0,72	+1,14

Source: Author's calculations. Gini-coefficients: SWIID 5.0 (2014), data for CAPB_U is available at OECD Statistical Compendium.

2.2.4.2. *Methodology: descriptive analysis as a first step*

Our ultimate goal is to analyze how fiscal adjustments influence income inequality. That is, we want to test whether the impact on income inequality is different between different fiscal episodes (consolidation, expansion, neutral) and whether the specific characteristics of the fiscal episode (composition, duration etc ...) play a role for this effect. Theoretically, the following characteristics of a specific fiscal episode can be thought to have an influence on income inequality:

- the size of the fiscal episode (adjustment, expansion), measured by the change in the underlying cyclically-adjusted primary balance ($\Delta CAPBu$),
- the change in non-interest expenditures,
- the change in specific categories of taxes (on business, on households and indirect taxes and social security contributions) and expenditures (government consumption, social security expenditures, public investments).

Moreover, we would also like to know the impact of the *design* of a consolidation program. That is, the institutional context in which consolidation takes place (union density, political ideology...) and the occurrence of simultaneous product or labour market reform. As far as we know, the influence of these reforms on the impact of fiscal consolidation on inequality/poverty has not yet been analyzed before.

As such, key questions we have in mind are:

- Do periods of fiscal consolidation generally lead to increases in income inequality? That is, can we confirm the findings of Agnello and Sousa (2014) in our different research set-up?
- Is the impact on inequality/poverty significantly different in periods of fiscal consolidation than in periods of fiscal expansion (or neutral fiscal periods)?
- Does the impact of fiscal tightening/expansion on income inequality depend on the specific composition and design of the consolidation package? By composition we refer to the specific combination of spending and tax measures that are part of the consolidation program. By design we refer to the institutional context, i.e. whether or not the fiscal adjustment occurs in a rigid or flexible labour/product market, if the program is accompanied by reform in labour or product markets...

This paper is a *first and necessary step* in answering these questions. We focus in this paper exclusively on fiscal consolidation periods (although we briefly touch the issue of fiscal expansion periods in Section 2.2.5.1.). In the spirit of Rawdanowicz *et al.* (2013), our goal is to perform a straightforward data-analysis (descriptive analysis) and focus on correlations to make a first inference about the relationship between fiscal adjustment and inequality.

Importantly, we should take into account a few caveats when interpreting the results. First, time series of income inequality measures corresponding to fiscal adjustment episodes are scarce. Rawdanowicz *et al.* (2013) correctly note that in many cases, consolidation was introduced after a deep recession and financial crisis, which themselves affected distribution. Moreover, prolonged consolidation periods could coincide with structural changes which contributed to a general increase in income inequality in the OECD. Third, one may use various definitions of income inequality and definitions of fiscal consolidation. Our future research will control for these caveats. After each analysis, we try to formulate a first and tentative conclusion.

2.2.5. Fiscal consolidation and inequality: hypotheses and data analysis

2.2.5.1. Consolidation versus expansion periods

In Table 2.2.1. we could observe that in 31 (resp. 28) out of 45 observed periods, the market (resp. net) GINI-coefficient increased after fiscal adjustment. In the other consolidation periods, GINI-coefficients remained stable or fell. On average, the link between consolidation and equity can thus clearly vary, confirming the findings of Rawdanowicz et al. (2013). A first comparison we make is whether the evolution of income inequality in the consolidation periods of Table 2.2.1. differs from the evolution in periods characterized by expansionary fiscal policy. Similarly to our periods of fiscal adjustment, we define a period of fiscal expansion as a well-defined period of at least two consecutive years in which the $CAPB_u$ deteriorated by at least two percentage points (see Heylen et al., 2013). We find 53 specific expansionary fiscal episodes in our set of countries since 1981 (detailed period characteristics available upon request). Table 2.2.2. shows for these periods some summary statistics, and the average observed change in GINI-coefficients.⁽²⁵⁾

Table 2.2.2.: Evolution in GINI-coefficients during and after periods of fiscal consolidation /expansion

Change in:	Market GINI		Net GINI	
	Consolidation	Expansion	Consolidation	Expansion
Average	1.14	1.54	0.72	0.33
Standard error	0.40	0.37	0.29	0.23
Median	0.86	1.67	0.55	0.44
Maximum	9.66	13.02	4.44	6.28
# observations	45	53	45	53

Source: Author's calculations

As to market GINI-coefficients, we find in Table 2.2.2. that expansionary fiscal episodes on average lead to larger increase in inequality than consolidation periods. The difference is not statistically significant, however. By contrast, when we consider net GINI-coefficients, the picture is somewhat different. Here, consolidation periods on average increase inequality more than expansionary periods. Again, the difference is not statistically significant (only on the 15%-level). The above statistics seem to suggest that the relationship between periods of fiscal consolidation and inequality is not clear. In any case, there is no evidence that on average periods of prolonged fiscal adjustment have lead to a higher increase in income inequality than periods of fiscal expansion.

2.2.5.2. Consolidation versus non-consolidation periods

The analysis in the previous section compares periods of fiscal adjustment with periods of fiscal consolidation. One drawback is that these periods occur at different time periods, and that we do not control for the fact that (i) the GINI-coefficient also knows an evolution outside periods of fiscal consolidation and (ii) the GINI-coefficient has generally known an upward trend since the 1980s. Therefore, in this subsection, we compare the evolution of the GINI-coefficient in periods of fiscal consolidation with the average evolution of the coefficient in all other countries that were not consolidating in the same period. We call the latter "periods of non-consolidation".

⁽²⁵⁾ More detailed information available upon request with the author.

Table 2.2.3.: Evolution of GINI-coefficients during and after periods of (non-)consolidation

Change in:	Market GINI		Net GINI	
	Consolidation	Non-consolidation	Consolidation	Non-consolidation
Average	1.14	0.80	0.72	0.36
Variance	7.31	0.51	3.82	0.24
p-value (one-sided) difference	0.21		0.12	
# observations	45	45	45	45

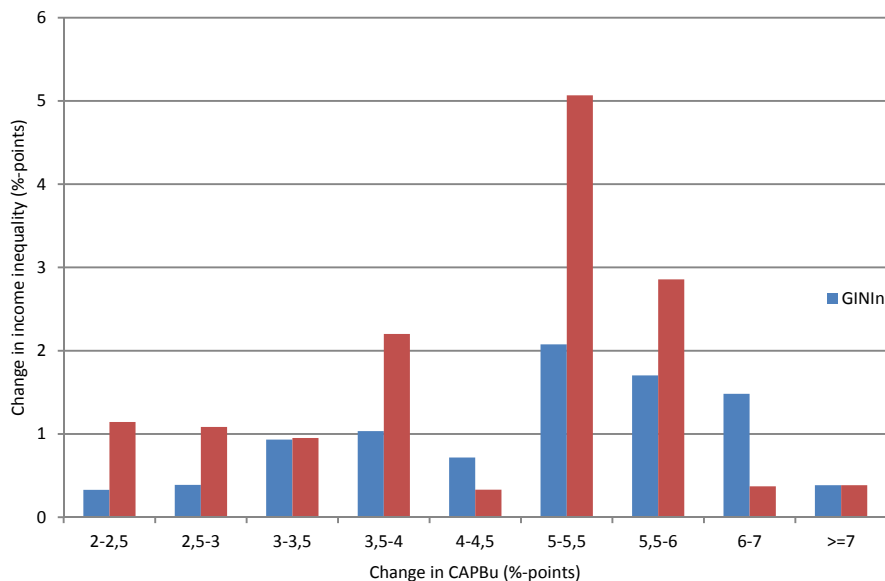
Source: Author’s calculations

In sum, Table 2.2.3. seems to suggest that, again on average, the net-*GINI* coefficient during the 45 periods of fiscal contraction increased somewhat more than in the other OECD-countries in the same years. This holds both for the market and net *GINI*-coefficient. Significance is limited, however. Even if the comparison between consolidation periods and expansion periods was ambiguous in Table 2.2.2., the results in Table 2.2.3. do seem to indicate a potential relationship between consolidation and increases in inequality.

2.2.5.3. Consolidation episodes: size

In Graph 2.2.1., we plot on the horizontal axis the change in the underlying *CAPB* for our 45 periods of fiscal consolidation and on the vertical axis the observed corresponding change in income inequality. Agnello and Sousa (2014) found that the size of the fiscal consolidation program has an impact on income inequality. In particular, when consolidation plans represent a small share of GDP, the income gap widens, suggesting that the burden associated with the effort affects disproportionately households at the bottom of the income distribution. Our descriptive analysis in Graph 2.2.1. shows a somewhat different picture. Although the relationship is not extremely clear, one may observe that the impact on inequality is bigger for larger consolidation packages. One reason may be that Agnello and Sousa (2014) define consolidation periods on a year-to-year basis and not as periods of multiple years, which may bias their results. This relationship and finding deserves further investigation in the future, controlling also for other characteristics of the consolidation period (duration, composition ...).

Graph 2.2.1.: Size and the change in income inequality



Source: Author’s calculations

2.2.5.4. Consolidation episodes: composition

In Table 2.2.4. we take a first look at the composition of a consolidation episode. Here, we label a period of fiscal consolidation as income-based when more than half of the change in underlying cyclically adjusted primary balance is explained by income-related measures (i.e. tax increases). A period is labeled as expenditure-based if more than half of the change in the $CAPB_u$ is due to expenditures cuts. Previous research (Agnello and Sousa, 2014) found that inequality increases in periods driven by spending cuts, whereas tax hikes seem to have a redistributing effect. Ball et al. (2013) found that both expenditure and taxed-based fiscal consolidations at the national level have typically raised inequality for a panel of OECD countries. The authors state that the distributional effects of spending-based adjustments tends to be larger relative to tax-based adjustments. The statistics in Table 2.2.4. seem to agree with Ball et al. (2013) in that inequality is observed to rise both during and after income-based as expenditure-based adjustments. However, the observed rise in the market en net $GINI$ -coefficient is on average larger for income-based than for expenditure-based, which is not in line with Ball et al. (2013) nor with Agnello and Sousa (2014).

Table 2.2.4.: Income-based versus expenditure-based consolidation episodes

Change in	Market GINI		Net GINI	
	Income based	Expenditure Based	Income based	Expenditure Based
Average	1.63	0.52	1.06	0.29
p-value (one-sided) difference	0.09		0.09	
# observations	25	20	25	20

Source: Author's calculations

In any way, Table 2.2.4. does suggest that composition could be an important driver of the impact of fiscal consolidation on inequality. To investigate this possibility somewhat further, we perform in this section some simple OLS-regressions where we analyze the impact of changes in specific categories of taxes or expenditures on income inequality during the defined periods of fiscal consolidation. The simple regressions are of the form:

$$\Delta Y_i = \alpha + \beta X_i + \epsilon_i \text{ for } i = 1 \dots 45$$

In which ΔY_i is the change in income inequality (market or net) and X_i is one of the variables reflecting composition in Table 2.2.5. (that is, observed changes in taxes or expenditures). That is, we test the correlation between changes in specific types of government expenditures or taxes on the one hand, and changes in income inequality on the other, in periods of fiscal adjustment.

Table 2.2.5.: Composition and the change in income inequality

X_i	$Y_i = GINI_m$		$Y_i = GINI_n$	
	$\hat{\beta}$	Two-sided p-value	$\hat{\beta}$	Two-sided p-value
Δ Social expenditures	-0,08	0,86	-0,20	0,56
Δ Public investment	0,83	0,17	0,35	0,44
Δ Social contributions	0,22	0,69	0,38	0,36
Δ Tax on business	1,28	0,10	1,00	0,08
Δ Tax on households	0,00	0,99	0,11	0,75
Δ Government consumption	0,25	0,29	0,04	0,81

Source: Authors' calculations

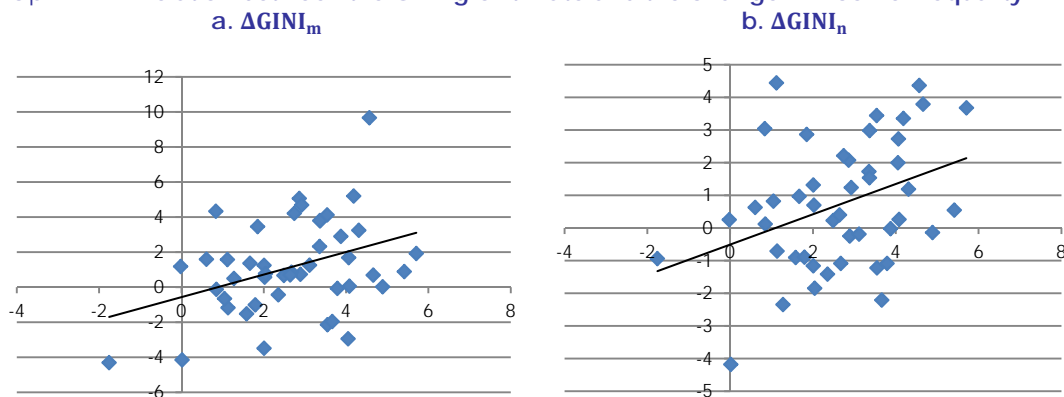
Our results seem to suggest that some categories of taxes or expenditures have a larger influence on inequality than others. For instance, we observe a negative correlation between the change in social expenditures and the change in the *GINI*-coefficients, although the coefficient is not significant. Public investment also seems important. Somewhat surprisingly, we observe a positive (and marginally significant) correlation between increases in taxes on business and increases in inequality. In any way, one needs to further investigate which mechanisms may drive these results. We think, for instance, at the impact of GDP growth. We touch this idea in the next section.

2.2.5.5. Consolidation episodes: growth

Economic growth has been shown to be an important driver of the outcome (success) of fiscal consolidation periods (see e.g. Heylen et al., 2013). Moreover, growth is also an important factor influencing income inequality. In this section, we show the average relationship between GDP growth and inequality. GDP growth might be a crucial factor in explaining the change in income inequality during periods of fiscal consolidation.

In Graph 2.2.2., we plot on the horizontal axis the average GDP growth rate in each of the periods of fiscal consolidation we consider. On the vertical axis, we plot the observed change in the *GINI*-coefficient. We do this both for the market and the net *GINI*-coefficient. We also show the OLS regression line.

Graph 2.2.2.: Relation between the GDP-growth rate and the change in income inequality



Source: Author's calculations based on OECD Statistical Compendium

Note: Horizontal axis: average growth rate in the period of fiscal consolidation (in %). Vertical axis: change in income inequality (GINI, in %-points).

In both graphs, the relationship between the GDP growth rate and the evolution of the *GINI*-coefficient is very clear. The simple correlation coefficient is also significant at the 5%-level. This seems to confirm the idea that higher growth rates tend to increase inequality, also during periods of fiscal adjustment. This result indicates the importance of controlling for growth when we want to further analyze the relationship between fiscal consolidation and inequality. In order to get a clear picture and idea on the impact of, for instance, composition of fiscal consolidation on income inequality, one needs to control for the impact GDP growth has on inequality, and for the impact composition of the consolidation package may have on GDP growth.

2.2.5.6. Consolidation episodes: institutions

Table 2.2.6. shows the coefficient of the regression equation of the change in income inequality (ΔY_i) on the value or change of specific institutional variables. As to the latter, we consider employment protection legislation (EPL), the degree of trade union density (UNION) and the size and changes in the indicator for product market regulation (PMR). The institutional context in which fiscal adjustments take places might influence its effect on income inequality. Although most of our results are insignificant, we get small indications that simultaneous product market regulation lowers the impact of consolidation on inequality (which seems also acceptable intuitively). Also, a higher level of employment protection legislation seems to lower income inequality during periods of fiscal consolidation. It seems definitely worth investigating these channels further.

Table 2.2.6.: Fiscal consolidation episodes and institutions

X_i	$Y_i = GINI_m$		$Y_i = GINI_n$	
	$\hat{\beta}$	Two-sided p-value	$\hat{\beta}$	Two-sided p-value
EPL	-0,43	0,28	-0,38	0,23
UNION	0,01	0,77	0,01	0,62
PMR	-0,04	0,91	-0,12	0,62
d(PMR)	-1,51	0,13	-0,93	0,24

Source: Author's calculations. EPL (OECD Employment Outlook), PMR (OECD.Stat), UNION (OECD Employment Outlook), COORD (Kenworthy, 2001)

2.2.6. Alternative measures for inequality and poverty

The above descriptive analysis considers one specific measure of inequality: the (net and gross) *GINI*-coefficients. *GINI*-coefficients, of course, are based on specific assumptions and methodologies and also have their flaws (we do not go into detail here). One may therefore wish to check other indicators such as the ratio of income deciles P50/10, P90/P10 ... which measure inequality at the top or bottom of the income distribution. Data availability however, in many cases, limits the possibility for in depth analysis. The same holds for analysis of poverty rates (measured as poverty gaps, ratio's or the income share of the poorest 10 % ...). As to poverty, we have tried to analyze how the poverty ratio changes during and after our periods of fiscal consolidation. Of the 45 observed consolidation periods in our dataset, we were able to calculate the change in poverty rates for only 23 periods. In 14 periods, one may observe a (small) increase in poverty, in 9 periods a decrease. On average, the change is not significantly different from zero.

2.2.7. Conclusion and directions for future research

The descriptive analysis performed in this paper offers some first ideas on the relationship between fiscal consolidation and income inequality. As most important takeaway, GDP growth seems to be a very important driver of inequality, confirming the idea that higher growth rates tend to increase inequality, also during periods of fiscal adjustment. Moreover, we find that on average, expenditure-based consolidation packages seem to increase inequality less than income-based packages. Finally, there are important indications that especially the composition of the fiscal consolidation package, and to a minor extent its institutional design, are important determinants.

The analysis in this paper is a first and necessary step to be able to analyze the relationship between fiscal consolidation periods and income inequality or poverty. It mainly consisted of defining well-defined periods of fiscal consolidation, gathering the required data for their analysis, and performing a first descriptive analysis. There are a few directions for future research, all (most) of them we are currently considering.

First, there are alternative measures for inequality and poverty besides the *GINI*-coefficient or simple poverty ratio's. In many cases, data availability is an issue, however. Nevertheless, checking robustness for different measures seems very interesting. Second, and perhaps most importantly, one may want/need to control for various characteristics simultaneously (GDP growth, composition, institutional context ...). Given the small number of observations/periods this was not yet possible in this paper. As an important extension to this study, we are combining the data collected for this paper, with data collected for expansionary and "neutral" fiscal episodes. This means taking into consideration the "total history of fiscal episodes" in our set of OECD countries, which would allow for a more extensive analysis (more observations) as in Heylen *et al.* (2013).

Finally, as our analysis suggested the possible important role of composition, one may want to further focus on the impact of changes in specific fiscal indicators (taxes, expenditures). Effects on inequality may counteract and cancel out. Rawdanowicz *et al.* (2013, their Table 1) rank various expenditure and income instruments according to their equity and growth implications. We also refer to our own research in Buyse and Heylen (2013) where we simulated various scenarios of fiscal adjustment using a general equilibrium model with overlapping generations and analyzed the impact of changes in different tax and expenditure items on welfare (and inequality). In the future, we hope that our empirical work may also contribute to this area of study.

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2.2.8. Discussion by Christian Kastrop(*)



**COMMENTS ON 'FISCAL
CONSOLIDATION AND INEQUALITY: AN
EMPIRICAL ANALYSIS' BY TIM BUYSE**

CHRISTIAN KASTROP
Director of Policy Studies
OECD Economics Department

Conference on Fiscal Policy After the Crisis
European Commission, Brussels, 19 January 2016



Structure

1. Summary of main results
2. A glimpse at key methodological points
3. Methodological suggestions
4. Policy questions
5. Suggestions to go forward

(*) OECD.

Main results

- This paper looks at overall effects and then focuses on the *context* and *composition* of fiscal consolidation.
- Overall effects: broadly in line with Rawdanowicz et al. (2013): only about half of fiscal consolidation episodes are associated with rising net inequality.
- New, fairly surprising evidence: market and net income inequality increase more in consolidation episodes that
 - are accompanied by *stronger economic growth*,
 - are based on *revenue increases* rather than *spending cuts*,
 - rely more on *business tax increases*, or
 - take place in countries *with less stringent job protection*, by comparison with other consolidation episodes.



3

Key methodological points

- Use of underlying primary balance taken from OECD Economic Outlook database.
- Consolidation episode defined as at least two years of improvement in this balance for a total of at least 2% of GDP (plus other technical conditions).
- 45 consolidation episodes over 1981-2008 in 21 OECD countries.
- Income inequality data from Frederic Solt's SWIID database.



4




Methodological suggestions

- Provide more information about the streams of income, tax and transfers that underpin Gini coefficients from the SWIID, as well as reference population.
- Check robustness by using OECD income inequality data, which are harmonised and cross checked (but their many missing years may be an obstacle).
- Check robustness to defining consolidation episodes with Devries et al.'s (2011) narrative approach.



5



A key question before drawing policy implications:

- To what extent are the puzzling results about composition and institutions (product market reform, job protection) driven by the identified role of growth?
 - More growth during consolidation is found to be associated with a larger increase in inequality
 - Hence, more successful consolidation (in growth terms) is linked with a bigger rise in inequality
- Controlling for growth therefore looks essential before analysing the impact of composition on inequality



6

Ideas for future research

- Why estimate only on consolidation periods rather than over all fiscal history: are they different? Do they involve a non-linearity?
- Do consolidation episodes influence inequality differently depending on whether they change the fiscal balance permanently or temporarily?
- How lasting are the inequality effects of the consolidation episodes identified in the paper?

7

OECD work suggests different impacts:

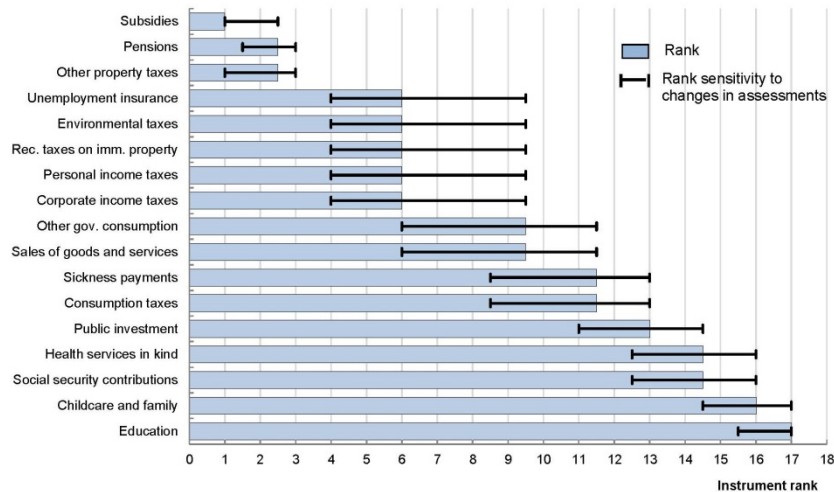
	Growth		Equity	
	Short term	Long term	Short term	Long term
<i>Spending cuts</i>				
Education	--	--	-	--
Health services provided in kind	--	-	-	-
Other government consumption	--	+	-	
Pensions		++		
Sickness and disability payments	-	+	--	-
Unemployment insurance	-	+	-	
Family	-	-	--	--
Subsidies	-	++	+	+
Public investment	--	--		
<i>Revenue increases</i>				
Personal income taxes	-	--	+	+
Social security contributions	-	--	-	-
Corporate income taxes	-	--	+	+
Environmental taxes	-	+	-	
Consumption taxes	-	-	-	
Recurrent property taxes	-			
Other property taxes	-		++	+
Sales of goods and services	-	+	-	-

Note: Blank cells mean unclear effects. Source: Cournède, Goujard and Pina (2014).

8



The instruments can be ranked



Source: Courmède, Goujard and Pina (2014).

9



Going forward: a granular approach to income distribution

- Move beyond inequality assessment based on the single Gini index, which is broadly reflecting developments in the middle of the income distribution
- To what extent does the impact of fiscal episodes affect differently different portions of the income distribution such as e.g. the poor, the rich, the middle class?
- Adopt a granular approach to income distribution, as used in recent strands of OECD work on structural reforms and income distribution (Causa et al., 2014)
- This is likely to deliver richer findings and address inequality and poverty within a coherent framework.

10



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2.3. ECONOMIC GROWTH AND PUBLIC AND PRIVATE INVESTMENT RETURNS⁽²⁶⁾

by António Afonso() and Miguel St Aubyn(*)*

2.3.1. Introduction

The 2008-2009 financial and sovereign debt crisis led to a substantial drop in both GDP and investment levels and growth rates. Moreover, it led to substantial changes in economic policy, namely budgetary policy. Under budgetary duress, the level of government indebtedness is deemed to have a negative impact on public investment in EMU member countries (see, for instance, Turrini, 2004, for the cases in the 1980s and in the 1990s). In fact, the abovementioned changes took in several countries the form of reduced expenditure, including public investment, and increased taxation. It is expectable that these changes may well constitute a policy regime change with structural implications on previous estimations regarding the relevance of investment for long-term growth.

Additionally, such policy changes, and especially in countries following adjustment programs, came with an emphasis on structural reforms that concern public spending levels and structure, and more generally, the way the economy and markets operate. It becomes then important to test if macroeconomic efficiency changes effectively occurred, and in what direction. For instance, Afonso and Jalles (2015) argue that the relevance of fiscal components differs for private and public investment developments.

Understanding and measuring linkages between public and private investment and economic growth are of crucial importance both in developed economies and emerging markets. Public investment is a part of public expenditure and decisions are taken within the larger framework of public finance. At the same time, it constitutes an addition to public capital. The latter, together with private and human capital, labour and other inputs, is in several approaches considered as a production factor. Public investment may therefore be linked to growth prospects. However, and as it is well documented in the literature, as part of public expenditure, it may crowd other types of investment, namely private, so that in some circumstances the net impact of public investment on GDP may be negative (see, for instance, Dreger and Reimers, 2014, Cavalcanti, et al., 2014, IMF, 2014).

At the same time, note the importance of public investment in the fiscal surveillance mechanisms of the EU, where n° 3 of Article 126 of the Treaty of the European Union (TEU, 2012) reads:

"If a Member State does not fulfil the requirements under one or both of these criteria, the Commission shall prepare a report. The report of the Commission shall also take into account whether the government deficit exceeds government investment expenditure and take into account all other relevant factors, including the medium-term economic and budgetary position of the Member State",

which indicates the preference for some Golden Rule based approach for public investment.

⁽²⁶⁾ We thank Narcissa Balta and participants at the DG ECFIN Workshop on "Fiscal policy after the crisis", 19 January 2016, Brussels, for useful comments and suggestions. The opinions expressed herein are those of the authors and do not necessarily reflect those of their employers.

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Moreover, the EC (2015) presented a new Investment Plan for Europe in support of its investment, structural reforms and fiscal responsibility strategy. Once more, the emphasis on investment is stressed, and a European Fund for Strategic Investments (EFSI) is created to promote the European Commission's Investment Plan for Europe, where it is mentioned that "co-financed expenditure should not substitute for nationally financed investments, so that total public investments are not decreased."⁽²⁷⁾

In this paper we contribute to the literature by using a VAR analysis for 17 OECD countries between 1960 and 2014 to assess the effects of public and private investment in terms of economic growth, crowding out and crowding in effects. In that context, we also compute public and private investment macroeconomic rates of return, and assess the potential effect of the 2008 economic and financial crisis, by comparison with previous shorter time span research, obtained before the crisis.

Our analysis provides notably the following results: public investment had a positive growth effect in most countries, and a contractionary effect on output in Finland, UK, Sweden, Japan, and Canada; positive public investment impulses led to private investment crowding-out in Belgium, Ireland, Finland, Canada, Sweden, the UK and crowding-in effect on private investment in the rest of the countries; private investment had a positive growth effect in all countries; private investment crowds-out public investment in Belgium and Sweden and crowds-in public investment in the remainder of the countries.

Moreover, the partial rate of return of public investment is mostly positive and the partial rate of return of private investment is only negative in Greece and marginally in Belgium.

The paper is organized as follows. In Section 2.3.2. we briefly review the literature and previous results. Section 2.3.3. outlines the analytical framework. In Section 2.3.4. we present and discuss our results. Section 2.3.5. is the conclusion.

2.3.2. Literature

There are several techniques and results that allow for crowding in and crowding out effects of public investment (see Afonso and St. Aubyn, 2009, 2010). Namely, and within a vector auto regression analysis, different rates of return are estimated. The total investment rate of return takes into account both private and public investment costs, while a partial rate of return only considers public investment as compared to GDP returns.

In Afonso and St. Aubyn (2009, 2010), the extent of crowding in or crowding out of both components of investment was assessed and the associated macroeconomic rates of return of public and private investment for each country were computed from impulse response functions. Results showed the existence of positive effects of public investment and private investment on output. Crowding in effects of private investment on public investment were more generalized than the reverse case.

These regularities are likely to be affected by major policy changes after 2009, namely due to the financial and sovereign debt crisis. In this project we intend to make further progress in this area of research, namely by studying the impact of the recent financial and sovereign debt crisis on the linkages between public and private investment and economic growth.

⁽²⁷⁾ Regarding the so-called Juncker plan Le Moigne et al. (2016) argue, in the context of an estimated DSGE model of the Eurozone economy, that it would have had a positive growth impact if it had been implemented at the beginning of the global economic and financial crisis.

IMF (2015) documents the private investment contraction in advanced economies during and after the economic and financial crisis. The "overall weakness of economic activity" is found to be the most important factor accounting for this shrinking. Our empirical modelling clearly encompasses this important channel, as private investment may react contemporaneously and/or with lags to GDP, to public investment, to taxes and to interest rates.

Some recent research provides evidence that more stringent financial conditions affect both how the economy reacts to public spending and investment and how investment responds to the economy. For the specific case of Japan, and using panel data techniques, Brückner and Tuladhar (2014) show that financial distress has a significant negative effect on the local government spending multiplier, while economic slack has a positive effect. For instance, Abiad et al. (2015) for 17 OECD economies report, via model simulations, that increasing public investment increases real growth and has a crowding-in effect on private investment.

In addition, and in the same vein, but also with a VAR methodology Dreger and Reimers (2014) refer that, and in what concerns the euro area, public investment decreases could have adversely affected private investment and GDP. In an interesting variation, Xu and Yan (2014) study crowding in and crowding out effects in China. They also resort to VAR analysis, and divide public capital formation in investment in public goods and infrastructure provision and investment involved in the private goods. Results suggest that the first crowds in private investment while the latter leads to crowding out.

The reader may also refer to our earlier work for further references on this subject.

Pereira (2000) introduced the estimation of macroeconomic rates of return for public investment. His VAR-based methodology was further developed by Pina and St. Aubyn (2005, 2006), who proposed the distinction between a partial and a total-cost rate of return. This research team, in Afonso and St. Aubyn (2009, 2010), estimated these rates of return for industrialized countries and also computed private investment rates of return, and extended previous research by considering a more complete VAR, by computing confidence bands and by generally presenting more detailed explanations and results.

2.3.3. Analytical framework

The VAR model

We estimate a five-variable VAR model for each country throughout the period 1960-2014 using annual data. As in Afonso and St. Aubyn (2010), where more detailed explanations may be found, we include five endogenous variables: the logarithmic growth rates of real public investment, I_{pub} , real private investment, I_{priv} , real output, Y , real taxes, Tax , and real interest rates, R .

The VAR lag length is determined by the usual information criteria.

The VAR is identified by means of a Cholesky decomposition. Variables are ordered from the most exogenous variable to the least exogenous one, public investment being the "most exogenous". By construction, structural shocks to private investment, GDP, taxes and the real interest rate affect public investment with a one-period lag. Private investment responds to public investment in a contemporaneous fashion, and to shocks to other variables with a lag.

The VAR model in standard form can be written as

$$X_t = c + \sum_{i=1}^p A_i X_{t-i} + \varepsilon_t \quad (1)$$

where X_t denotes the (5×1) vector of the five endogenous variables given by $X_t \equiv [\Delta \log I_{pub_t}, \Delta \log I_{priv_t}, \Delta \log Y_t, \Delta \log Tax_t, \Delta R_t]'$, c is a (5×1) vector of intercept terms, A_i is the matrix of autoregressive coefficients of order i , and the vector of random disturbances $\varepsilon_t \equiv [\varepsilon_t^{I_{pub}}, \varepsilon_t^{I_{priv}}, \varepsilon_t^Y, \varepsilon_t^{Tax}, \varepsilon_t^R]'$ contains the reduced form OLS residuals. The lag length of the endogeneous variables, p , will be determined by the usual information criteria.

Macroeconomic rates of return

We compute four different rates of return: r_1 , the partial rate of return of public investment; r_2 , the rate of return of total investment (originated by an impulse to public investment); r_3 , the partial rate of return of private investment; r_4 , the rate of return of total investment (originated by an impulse to private investment).

These rates are derived from the VAR impulse response functions, as explained in Afonso and St. Aubyn (2009). In the following lines we provide the economic interpretation to these variables.

The partial rate of return of public investment, r_1 , compares a (partial) cost, public investment, to a benefit, GDP change, following an impulse to public investment.

The rate of return of total investment (originated by an impulse to public investment), r_2 , compares the total cost (public plus induced private investment), to the same benefit, GDP change. If more public capital induces more private investment, we will call this a crowding in case, and r_1 will exceed r_2 . Moreover, if a positive impulse in public investment leads to a private investment decrease, than r_1 will be smaller than r_2 .

In some cases a positive impulse to public investment will lead to a decrease in GDP. In those occasions it will not be feasible to compute a rate of return. Note that a negative rate of return will arise when the benefits, albeit positive, are smaller than costs.

The rates of return r_3 and r_4 concern the measurement of consequences to positive impulses in private investment. As in the case of public investment impulses, we may have that private investment leads to the crowding in of public investment, or else that government reacts to private investment impulse by diminishing capital formation (the crowding out case). In the latter case, r_3 will be smaller than r_4 . The detailed analytics of the computation of the macroeconomic rates of return are summarised in Appendix 2.3.1.

2.3.4. Empirical analysis

Dataset

We use annual data for 14 EU countries (sample in parenthesis): Austria (1965–2014), Belgium (1970–2014), Denmark (1971–2014), Germany (1970–2014), Finland (1961–2014), France (1970–2014), Greece (1973–2014), Ireland (1971–2014), Italy (1970–2014), the Netherlands (1969–2014), Portugal (1981–2014), Spain (1979–2014), Sweden (1971–2014), the UK (1970–2014), plus Canada (1964–2004), Japan (1972–2014), and the United States (1961–2014).

In order to control for the beginning of the 3rd stage of the Economic and Monetary Union, and the launching of the euro, on the 1st of January 1999, we have used a dummy variable that takes the

value one from 1999 onwards inclusively. Such variable is statistically significant in several countries, notably regarding the long-term interest rate.⁽²⁸⁾

Table 2.3.1. summarises the country-specific investment series while Graph 2.3.1. plots the 17 country average private and public investment-to-GDP ratios.

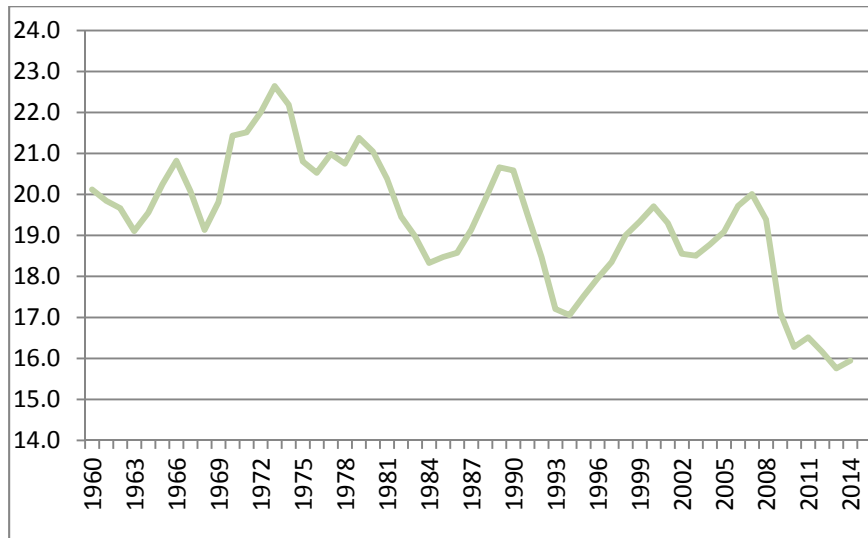
Table 2.3.1.: Public and private investment -to-GDP ratios

	Public investment-to-GDP ratios				Private investment-to-GDP ratios			
	1970	1980	2010	1960-14	1970	1980	2010	1960-14
AUT	4,7	4,2	3,2	3,5	19,7	20,2	18,4	20,1
BEL	4,8	5,3	2,2	2,7	22,3	19,7	20,1	19,3
DEU	4,8	3,7	2,3	2,8	21,5	19,5	17,0	19,0
DNK	4,7	3,8	3,3	3,1	20,0	16,6	14,9	17,5
ESP	2,9	2,1	4,7	3,5	23,4	20,3	18,3	20,1
FIN	4,2	4,3	3,7	4,1	23,5	23,0	18,2	20,6
FRA	4,9	4,1	4,1	4,2	20,7	20,2	17,9	18,2
GBR	6,2	3,4	3,2	2,8	17,4	18,2	12,8	16,9
GRC	2,9	2,2	3,2	3,1	25,4	29,2	14,0	19,2
IRL	4,2	5,7	3,4	3,2	19,3	23,3	12,4	17,8
ITA	3,5	3,8	2,9	3,2	21,7	21,8	17,0	18,3
NLD	6,3	4,7	4,1	4,2	22,7	18,5	15,6	18,0
PRT	2,4	4,6	5,3	3,3	21,9	24,4	15,3	21,1
SWE	8,3	5,4	4,5	4,9	18,6	17,7	17,7	17,8
CAN	3,9	2,9		2,8	17,0	19,9		17,5
JAP	4,8	5,7	3,3	4,6	32,2	25,8	16,7	22,2
USA	5,2	4,3	4,1	4,1	15,9	19,1	13,9	17,3
Max	8,3	5,7	5,3	4,9	32,2	29,2	20,1	22,2
Min	2,4	2,1	2,2	2,7	15,9	16,6	12,4	16,9

Source: EC, AMECO Database, updated on April 2015.

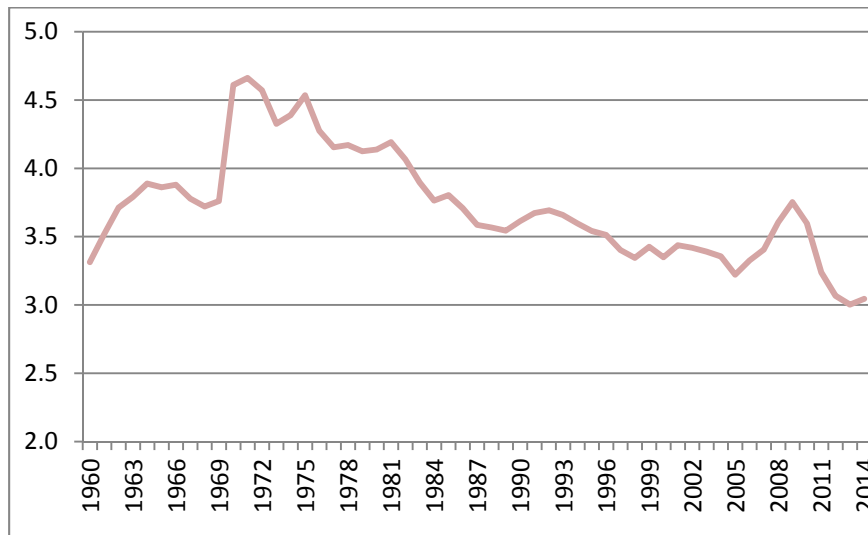
⁽²⁸⁾ To control for the reunification process a dummy was also used for the case of Germany in 1991.

Graph 2.3.1.: Private and public investment-to-GDP ratios, average of all countries
a: Private investment (% of GDP)



Source: Authors' calculations

b: Public investment (% of GDP)



Source: Authors' calculations

In order to estimate our VAR for each country, we use information for the following data series: GDP at current market prices; price deflator of GDP; general government gross fixed capital formation at current prices, used as public investment; gross fixed capital formation (GFCF) of the private sector at current prices, used as private investment; taxes (including direct taxes, indirect taxes and social contributions); nominal long-term interest rate and the consumer price index.

GDP, taxes and investment variables are used in real values using the price deflator of GDP and the price deflator of the GFCF of the total economy.⁽²⁹⁾ A real ex-post interest rate is computed using the consumer price index inflation rate. All data are taken from the European Commission Ameco database.⁽³⁰⁾

All variables enter the VAR as logarithmic growth rates, except the interest rate, where first differences of original values were taken. Moreover, the first differenced variables are mostly stationary, I (0) time series. Table 2.3.2. shows unit root test statistics.

Table 2.3.2.: Unit root tests, variables in first differences: Augmented Dickey-Fuller test statistics

	dlog(Y)		dlog(Ipub)		dlog(Ipriv)		dlog(tax)		dir	
	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value
Austria	-5.09	-3.56	-6.44	-3.56	-6.21	-3.56	-4.50	-3.56	-9.03	-3.57
Belgium	-5.03	-3.56	-5.88	-3.59	-4.89	-3.59	-4.02	-3.59	-9.34	-3.56
Denmark	-5.28	-3.56	-6.37	-3.59	-4.99	-3.60	-5.51	-3.59	-10.61	-3.56
Finland	-4.55	-3.56	-7.48	-3.59	-4.29	-3.59	-5.53	-3.56	-6.77	-3.56
France	-3.38	-2.92 \$	-4.62	-3.59	-4.36	-3.59	-4.41	-3.59	-8.40	-3.56
Germany	-5.68	-3.56	-4.46	-3.59	-4.84	-3.59	-5.57	-3.59	-9.35	-3.56
Greece	-3.57 a	-3.50 \$	-5.87	-3.59	-4.86	-3.59	-4.57	-3.59	-7.23	-3.56
Ireland	-3.66	-3.56	-3.79	-3.59	-4.37	-3.59	-5.33	-3.59	-6.56	-3.56
Italy	-7.33 a	-4.14	-6.47	-4.19	-5.06	-4.19	-6.99	-4.19	-6.55	-4.14
Netherlands	-3.58	-3.56	-5.58	-3.59	-4.51	-3.59	-5.42	-3.59	-10.17	-3.56
Portugal	-3.42	-2.92 \$	-5.56	-3.59	-5.45	-3.59	-5.42	-3.59	-8.96	-3.56
Spain	-3.21	-2.92 \$	-4.50	-3.59	-3.72	-3.59	-4.30	-3.59	-6.87	-3.63
Sweden	-5.49	-3.56	-6.93	-3.59	-4.32	-3.59	-4.39	-3.59	-12.04	-3.56
UK	-5.17	-3.56	-7.95	-3.59	-4.93	-3.59	-5.06	-3.59	-9.60	-3.56
Canada	-4.10	-3.56	-5.39	-3.59	-4.23	-3.64	-4.82	-3.61	-7.11	-3.56
Japan	-5.62 a	-3.56	-4.72	-3.59	-4.89	-4.18	-4.20	-3.59	-4.29	-3.56
US	-5.04	-3.56	-3.40 \$	-2.93	-4.12	-3.59	-5.50	-3.59	-7.09	-3.56

Note: critical values are for 1% level unless otherwise mentioned.

- 10% level; \$ - 5% level. a - with constant and trend

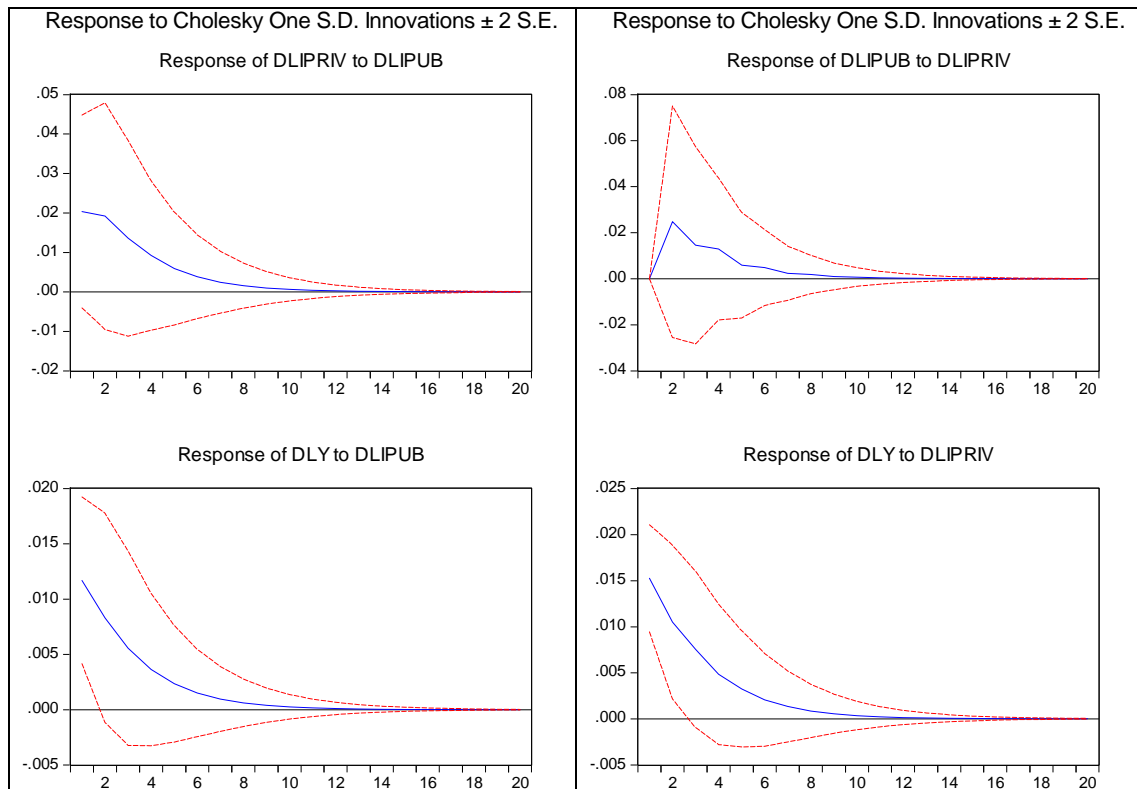
⁽²⁹⁾ Due to the lack of information on a price deflator for private investment, we use the same deflator to compute both public and private investment variables.

⁽³⁰⁾ The data sources are mentioned in Appendix 2.3.2.

Crowding-out and crowding-in effects

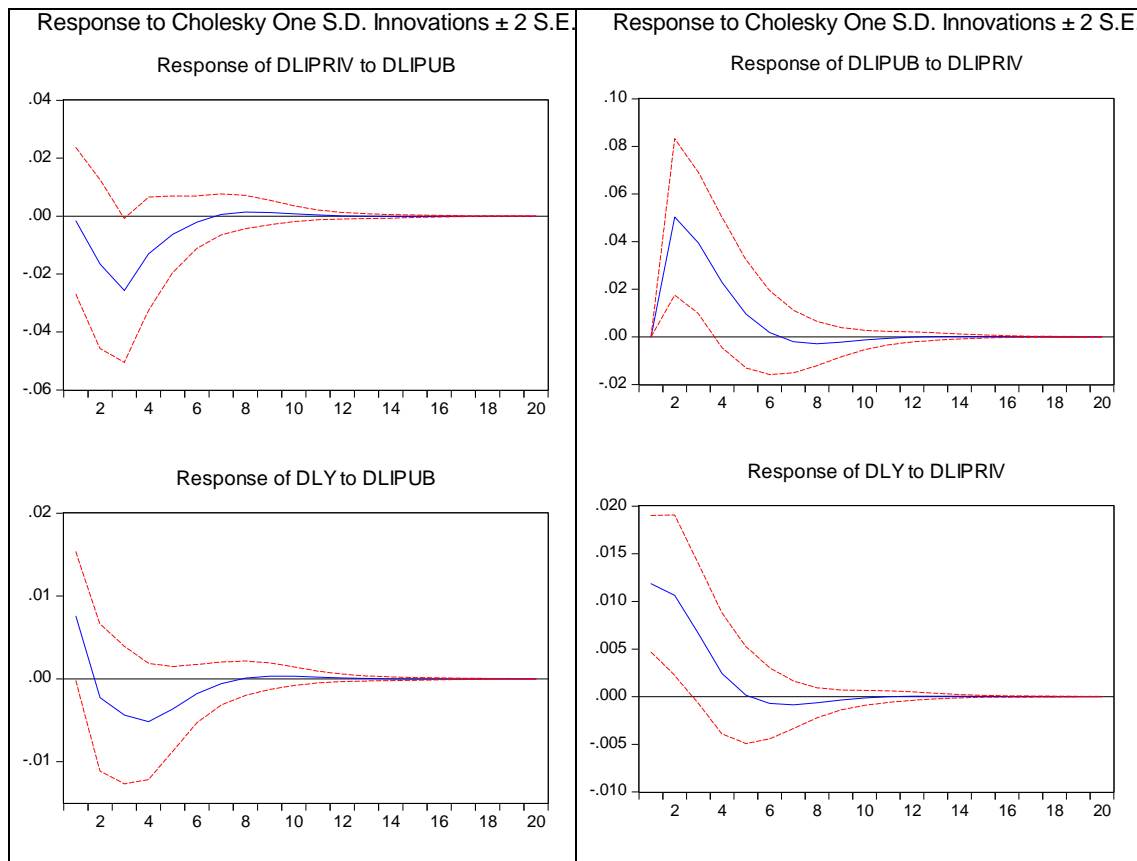
Graphs 2.3.2. and 2.3.3. show the impulse response functions from a one standard deviation shock to public investment and to private investment, respectively for the cases of Portugal and Ireland, as an illustration. It is clear from these charts that a public investment shock may have a different impact on private investment, implying a crowding-in effect in Portugal and crowding-out effect in Ireland.

Graph 2.3.2.: Impulse response functions, Portugal (1981-2014)



Source: Authors' calculations

Graph 2.3.3.: Impulse response functions, Ireland (1971-2014)



Source: Authors' calculations

Table 2.3.3. summarises the results for the long-run elasticities, the marginal productivity rates and the macroeconomic rates of return, partial and total, for both public and private investment for the period 1960-2014 for the 17 country set.

Table 2.3.3.: Long-run elasticities, marginal productivity and rates of return (1960-2014)

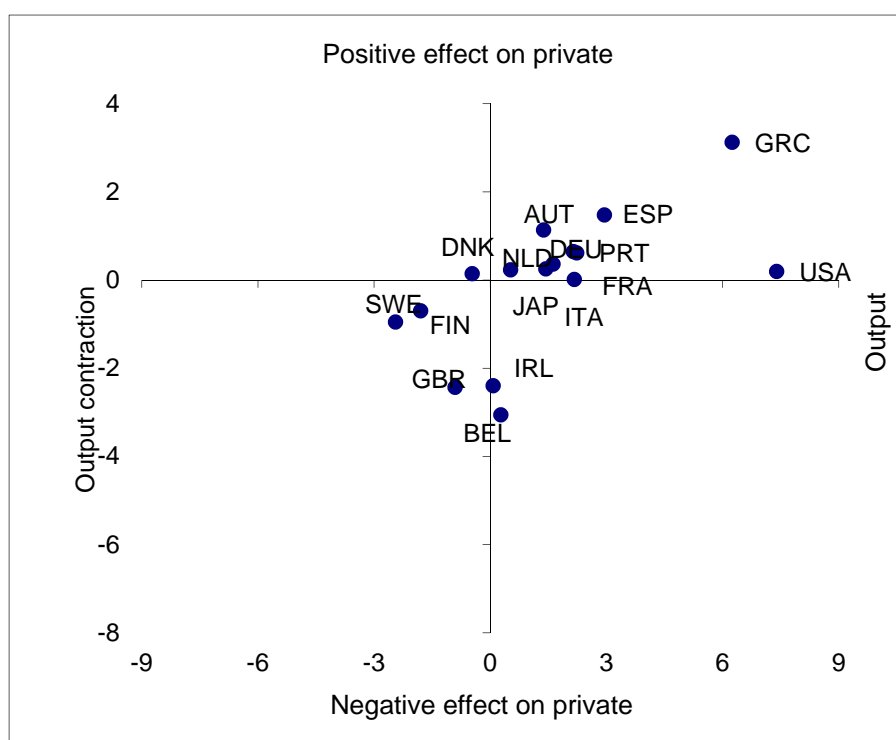
a) Impulse on public investment					
	Output elasticity	<i>MPI_{pub}</i>	Partial rate of return (%)	<i>MPTI</i>	Total rate of return (%)
Austria	0.019	0.525	-3.17	0.427	-4.16
Belgium	0.007	0.275	-6.25	-0.134	
Denmark	0.045	1.436	1.83	1.148	0.69
Finland	-0.073	-1.799		-5.977	
France	0.091	2.170	3.95	2.145	3.89
Germany	0.039	1.376	1.61	0.645	-2.17
Greece	0.191	6.246	9.59	-0.055	2.10
Ireland	0.002	0.078	-12.00	-0.055	
Italy	0.052	1.620	2.44	1.191	0.88
Netherlands	0.089	2.148	3.90	1.307	1.35
Portugal	0.073	2.231	4.09	1.383	1.64
Spain	0.102	2.949	5.56	1.192	0.88
Sweden	-0.120	-2.446		-52.819	
United Kingdom	-0.026	-0.909		0.635	-2.25
Canada	-0.315	-11.115		2.016	3.57
Japan	-0.022	-0.467		-0.409	
United States	0.302	7.396	10.52	6.193	9.55

b) Impulse on private investment					
	Output elasticity	<i>MPI_{priv}</i>	Partial rate of return (%)	<i>MPTI</i>	Total rate of return (%)
Austria	0.239	1.192	0.88	1.142	0.66
Belgium	0.170	0.883	-0.62	0.910	-0.47
Denmark	0.181	1.034	0.17	1.000	0.00
Finland	0.264	1.284	1.26	1.259	1.16
France	0.312	1.719	2.75	1.599	2.37
Germany	0.301	1.583	2.32	1.525	2.13
Greece	0.024	0.123	-9.94	0.123	-9.94
Ireland	0.326	1.830	3.07	1.523	2.13
Italy	0.355	1.943	3.38	1.630	2.47
Netherlands	0.254	1.412	1.74	1.320	1.40
Portugal	0.319	1.512	2.09	1.397	1.69
Spain	0.304	1.515	2.10	1.197	0.90
Sweden	0.179	1.010	0.05	1.040	0.20
United Kingdom	0.175	1.034	0.17	0.943	-0.29
Canada	0.208	1.189	0.87	1.168	0.78
Japan	0.395	1.779	2.92	1.773	2.91
United States	0.339	1.958	3.42	1.935	3.36

Notes: na – not available. The rate of return cannot be computed in this case since the marginal productivity is negative. *MPI_{pub}* – marginal productivity of public investment. *MPI_{priv}* – marginal productivity of private investment. *MPTI* – marginal productivity of total investment. We use the average of the GDP-to-investment ratios for the period 1960-2014 (or starting later, depending on data availability, see notably the sample sizes mentioned before).

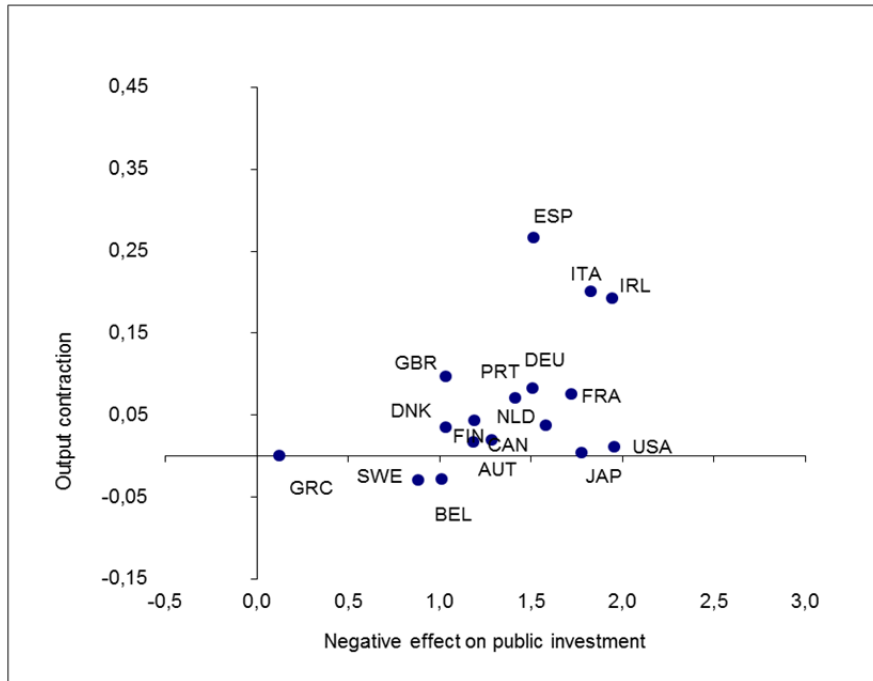
Graph 2.3.4. displays on the vertical axis the marginal effects of public investment on private investment, allowing the assessment of the existence of crowding-in or crowding-out effects of public investment on private investment. As Graph 2.3.4. shows, public investment has a positive growth impact in 12 countries and negative one on 5 countries (Finland, UK, Sweden, Japan, and Canada). Moreover, public investment has a crowding-in effect on private investment in 11 of the 17 countries analysed. Of the six countries in which public investment crowds-out effect on private investment, two (Belgium and Ireland) experience a slight output expansion, while Finland, Canada, Sweden, the UK, show a contractionary effect.

Graph 2.3.4.: Public investment: marginal productivity (horizontal) and marginal effect on private investment (vertical), (1960-2014)



Note: AUT – Austria; BEL – Belgium; CAN – Canada; DEU – Germany; DNK – Denmark; ESP – Spain; FIN – Finland; FRA – France; GBR – United Kingdom; GRC – Greece; IRL – Ireland; ITA – Italy; JAP – Japan; NLD – Netherlands; PRT – Portugal; SWE – Sweden; USA – United States.

Graph 2.3.5.: Private investment: marginal productivity (horizontal) and marginal effect on public investment (vertical), (1960-2014)



Note: see Graph 2.3.4.

In a similar way we report in Graph 2.3.5. the effects of private investment on output and the existing crowding-in or crowding-out effects of private investment on public investment. Moreover, it is also possible to conclude that private investment has an expansionary effect on output for all 17 countries in the sample. Graph 2.3.5. also reveals that private investment crowds-in public investment for most countries in the sample, and crowds-out public investment in the cases of Belgium, and Sweden. This is an outcome quite in line with the results reported by Afonso and St. Aubyn (2009), for the period 1960-2004.

Table 2.3.4. provides a comparison between the results in this paper, for the period 1960-2014 and the results of Afonso and St. Aubyn (2009) covering the period 1960-2004. Therefore, the current study encompasses the period of 2008-2009 economic and financial crisis.

Table 2.3.4.: Marginal productivity and rates of return, 1960-2004 vs 1960-2014

		Effect of public investment shock			Effect of private investment shock		
		Marginal productivity of public investment	Marginal IPUB effect on IPRIV	Total rate of return (with feedback effects), %	Marginal productivity of private investment	Marginal IPRIV effect on IPUB	Total rate of return (with feedback effects), %
PRT	I	5.18	5.21	-0.9%	1.35	0.16	1.4%
	II	2.23	0.61	1.6%	1.51	0.27	0.9%
AUT	I	1.60	2.45	-3.8%	1.45	0.07	1.5%
	II	0.52	0.23	-4.2%	1.19	0.04	0.7%
BEL	I	-0.43	-3.02	-7.4%	0.86	-0.03	-0.6%
	II	0.27	-3.06	na	0.88	-0.03	-0.5%
DEU	I	1.72	0.53	0.6%	1.47	0.03	1.8%
	II	1.38	1.13	-2.2%	1.58	0.04	2.1%
DNK	I	2.54	1.54	0.0%	0.95	0.04	-0.5%
	II	1.44	0.25	0.7%	1.03	0.03	0.0%
FIN	I	0.44	0.34	-5.4%	1.06	0.02	0.2%
	II	-1.80	-0.70	na	1.28	0.02	0.2%
ESP	I	2.66	0.72	2.2%	1.56	0.18	1.4%
	II	2.95	1.47	0.9%	1.52	0.27	0.9%
FRA	I	1.53	-0.56	6.5%	1.35	0.06	1.2%
	II	2.17	0.01	3.9%	1.72	0.08	2.4%
GBR	I	-1.62	-2.03	2.3%	1.84	0.09	2.7%
	II	-0.91	-2.43	-2.2%	1.03	0.10	-0.3%
GRC	I	2.39	1.58	-0.4%	0.91	-0.08	0.0%
	II	6.25	3.12	2.1%	0.12	0.00	-9.9%
IRL	I	-1.60	-2.77	-0.5%	1.85	0.30	1.8%
	II	0.08	-2.40	na	1.83	0.20	2.1%
ITA	I	0.51	-0.80	4.8%	1.11	-0.34	2.7%
	II	1.62	0.36	0.9%	1.94	0.19	2.5%
NLD	I	-2.72	-2.35	3.6%	1.78	0.07	2.6%
	II	2.15	0.64	1.3%	1.41	0.07	1.4%
SWE	I	0.13	0.40	-11.3%	1.08	-0.09	0.9%
	II	-2.45	-0.95	na	1.01	-0.03	0.2%
CAN	I	-2.31	-2.30	2.9%	1.28	0.03	1.1%
	II	-11.12	-6.52	3.6%	1.19	0.02	0.8%
JAP	I	0.01	-0.99	0.8%	3.09	0.43	3.9%
	II	-0.47	0.14	na	1.78	0.00	2.9%
USA	I	1.83	-2.98	na	2.03	0.06	3.3%
	II	7.40	0.19	9.5%	1.96	0.01	3.4%

Notes: I - 1960-2004 (Afonso and St. Aubyn, 2009); II - 1960-2014. na - not available. The rate of return cannot be computed in this case since the marginal productivity is negative. IPUB - public investment; IPRIV - private investment. AUT - Austria; BEL - Belgium; CAN - Canada; DEU - Germany; DNK - Denmark; ESP - Spain; FIN - Finland; FRA - France; GBR - United Kingdom; GRC - Greece; IRL - Ireland; ITA - Italy; JAP - Japan; NLD - Netherlands; PRT - Portugal; SWE - Sweden; USA - United States.

For the cases where such comparison is feasible, Table 4 makes it possible to draw some additional results, for the period 1960-2014 vis-à-vis the period before the crisis. Regarding the marginal productivity of public investment, there was an increase in nine countries, while the marginal productivity of private investment increased in seven cases between the two periods. In around half of the countries, the increase (decrease) in the marginal productivity of private or public investment takes place alongside the reduction (increase) in the investment-to-GDP ratio. In the remaining cases that parallel is not present given the compensating opposite effect (vis-à-vis the investment ratio) of the change in respective the output elasticity to investment.

Therefore, the total rate of return of public investment increased in three countries (Portugal, Denmark, and Greece) and decreased in seven countries (Austria, Germany, Spain, Finland, the UK, Italy and the Netherlands). In addition, the total rate of return of private investment increased in five countries (Belgium, Germany, Denmark, France, and Ireland) and decreased in all the other countries but the USA, where it remained essentially unchanged.

2.3.5. Conclusion

In this paper we have used a VAR analysis for 17 countries OECD between 1960 and 2014 to assess the effects of public and private investment in terms of economic growth, crowding out and crowding in. In that context, we also compute public and private investment macroeconomic rates of return, and assessed the potential effect of the 2008 economic and financial crisis.

Our results for the effects of investment shocks show that

- i. public investment had a positive growth effect in most countries;
- ii. public investment had a contractionary effect on output in five cases (Finland, UK, Sweden, Japan, and Canada);
- iii. positive public investment impulses led to a decline in private investment (crowding-out) in six countries (Belgium, Ireland, Finland, Canada, Sweden, the UK);
- iv. public investment had a crowding-in effect on private investment in the remainder 11 countries;
- v. private investment had a positive growth effect in all countries;
- vi. private investment crowds-out public investment in the cases of Belgium, and Sweden;
- vii. private investment crowds-in public investment in the remainder 15 countries.

Moreover, the partial rate of return of public investment is mostly positive, with the exceptions of Austria, Belgium, and Ireland, while the total rate of return of public investment is also negative in Germany and in the UK. On the other hand, the partial rate of return of private investment is only negative in Greece and marginally in Belgium, being the total rate of return of private investment negative for Belgium, Greece, and the UK.

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2.3.6. Discussion by Narcisa Balta(*)



Discussion: "Economic Growth and Public and Private Investment Returns"

by Antonio Afonso and Miguel St.Aubyn

Workshop: 'Fiscal Policy after the crisis'
Brussels, 19 January 2016

Discussant: Narcissa Balta

Macroeconomy of the euro area
Directorate-General for Economic and Financial Affairs



Motivation for the paper: very relevant

Has the financial and sovereign crisis changed the relevance of investment (public and private) for GDP growth in the long run?

Measure linkages between public and private investment: crowding out and crowding in effects

Methodology: structural VAR analysis, 17 OECD countries, 1960-2014, AMECO data. Cholesky decomposition. VAR in differences on 5 endogenous real variables.

$X \equiv [\Delta \log I_{pub}, \Delta \log I_{priv}, \Delta \log Y, \Delta \log Tax, \Delta R]$

(*) European Commission, DG ECFIN.



Macroeconomic rates of return:

Long-run MP of public investment : based on the long-run elasticity of Y with respect to public investment (accumulated IRFs) and the average GDP-to-public investment ratio – **partial return of public investment**

Long-run MP of private investment : based on the long-run elasticity of Y with respect to private investment (accumulated IRFs) and the average GDP-to-private investment ratio – **partial return of private investment**

Return on total investment – takes into account also the interaction between the two, following either a "positive impulse" in public investment or in private investment



Main results:

Public investment ('positive impulse') has a positive growth effect in most countries, and a contractionary effect on output in FI, UK, SE, JP and CA

Crowding-out of private INV: BE, IE, FI, CA, SE, and UK

Crowding-in of private INV: in the rest of the countries

Private investment ('positive impulse') has a positive growth effect in all countries

Crowding-out of public INV: BE and SE

Crowding-in of public INV: in the rest of the countries





Comment 1: policy instability

Structural VAR analysis – includes variables affected by major policy changes during the crisis

Constant parameter structural VARs that miss policy instability are improperly identified = misspecification in constant coefficient VAR models estimated over long sample periods



Changes in economic relationships since the crisis:

Methodology: *Vector autoregressions (VARs) tools for large data sets, based on recent advances in the literature:*

a large Bayesian VAR, both in levels and in differences (Banbura et al, 2015, Giannone et.al, 2014). Both models point qualitatively towards the same conclusions

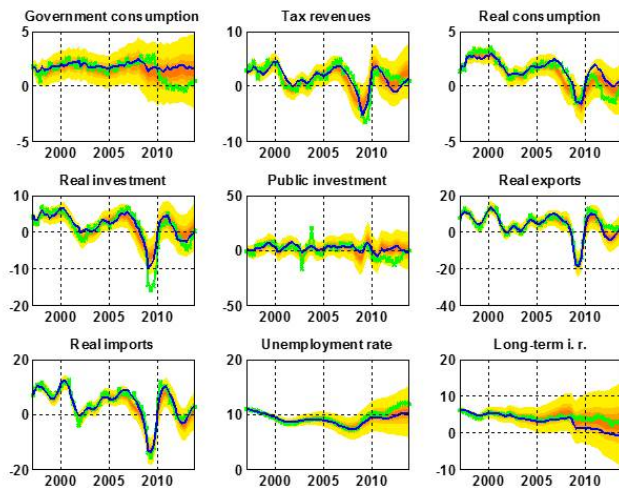
Data from 1996Q1 to 2013Q4, 28 macro variables for the EA:

- estimation of economic relationships for the pre-crisis period, 1996Q1-2007Q4*
- conditional forecasts computed for 1996Q1 to 2013Q4, recursively using Kalman filtering and a simulation smoother (Banbura et al, 2015, Durbin and Koopman, 2002).*
- conditional on observed EA real GDP, inflation, and ST interest rates: reduced form model, no need to identify structural shocks.*





Public consumption, incl. public investment: large deviations from past correlations with economic activity during the sovereign crisis



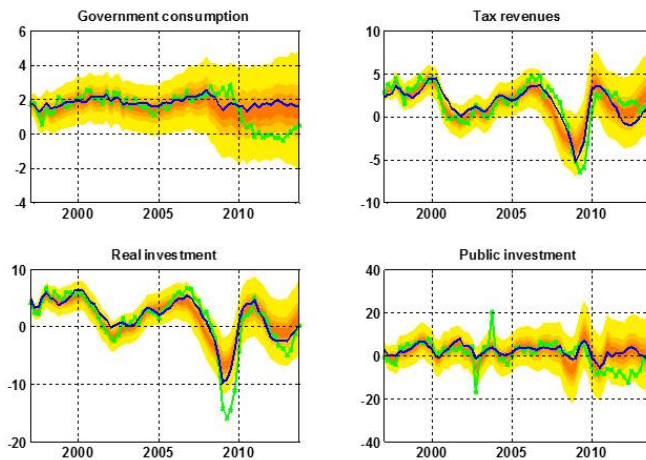
Conditional forecasts:

Shades of orange: distribution of the conditional forecasts in the BVAR in levels, excluding the lower and higher 5 % quintiles. Solid blue line: point estimate of the conditional forecasts in the BVAR in differences, which is calculated as the median of the distribution of the conditional forecasts in this model. Green line with crosses: actual values. The variables are all reported in terms of annual percentage changes. Conditioning assumptions: real GDP, inflation and short-term interest rates.

Source: DG ECFIN, AWM fiscal data.



Public consumption, incl. public investment: large deviations from past correlations with economic activity during the sovereign crisis



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Source: DG ECFIN, AWM fiscal data.



Comment 2: inference

Granger causality tests.

Uncertainty around the IRFs estimates: confidence bands.

Need to explicitly recognize the uncertainty in the assumptions that underlie the structural VAR analysis and see what inferences, or range of inferences, still can be made.

OLS estimator tends to underestimate persistence in AR models when a small sample is available. This affects IRFs, notably at longer lags.



Comment 3: omitted information?

2008-2013: financial and sovereign crisis.

No financial variable included in the VAR.

Omitted variable bias: ends up in the VAR residuals and (incorrectly) become part of the estimated historical 'shocks' used to estimate an impulse response.

VAR in differences: time series with substantial persistence and co-movement.





Comment 4 : some EU aspects

Public investment in EU MSs that are net recipients of structural funds is likely to be more closely linked to private investment through the co-funding (ES, PT, EL)

PPPs: Several EU MSs use private-public partnerships for large infrastructure projects (PT, ES, IE, UK)



Conclusion

A very interesting and topical issue

A nice and easy illustration of the interaction between investment and long-term growth

Several aspects related to the methodology and its limitations need to be more thoroughly discussed in the paper, including the uncertainty around the parameter estimates.





Thank you for your attention

Narcissa Balta (A5)

Directorate-General for Economic and Financial Affairs



Bayesian approach:

Parameters are considered as random variables and the aim is to describe uncertainty about parameters conditional on the data at hand – the posterior density

The posterior combines information from the data (contained in the likelihood $p(y/\theta)$) and from other sources (contained in the prior $p(\theta)$). Bayes' rule to obtain the posterior density: $p(\theta/y)$, which is proportional to $p(y/\theta) p(\theta)$.

Priors of the large BVAR (Sims, Zha, Litterman): Conjugate priors belonging to normal-inverse-Wishart family, adding "inexact-differencing" and "dummy-initial-observation" prior. Hyperparameters chosen as in Giannone, Lenza and Primiceri (2014)

Appendix 2.3.1. The analytics of the macro rates of return

We compute the long-run accumulated elasticity of Y with respect to public investment, I_{pub} , from the accumulated impulse response functions (IRF) of the VAR, as

$$\varepsilon_{I_{pub}} = \frac{\Delta \log Y}{\Delta \log I_{pub}} \quad (A1)$$

The long-term marginal productivity of public investment is given by

$$MPI_{pub} \equiv \frac{\Delta Y}{\Delta I_{pub}} = \varepsilon_{I_{pub}} \frac{Y}{I_{pub}} \quad (A2)$$

The partial-cost dynamic feedback rate of return of public investment, r_1 , is the solution for:

$$(1 + r_1)^{20} = MPI_{pub} \quad (A3)$$

The long-term accumulated elasticity of Y with respect to I_{priv} can also be derived from accumulated IRF in a similar way:

$$\varepsilon_{I_{priv}} = \frac{\Delta \log Y}{\Delta \log I_{priv}} \quad (A4)$$

and the long-term marginal productivity of private investment is given by

$$MPI_{priv} \equiv \frac{\Delta Y}{\Delta I_{priv}} = \varepsilon_{I_{priv}} \frac{Y}{I_{priv}} \quad (A5)$$

Therefore, the marginal productivity of total investment, $MPTI$, is as follows:

$$MPTI = \frac{\Delta Y}{\Delta I_{pub} + \Delta I_{priv}} = \frac{1}{MPI_{pub}^{-1} + MPI_{priv}^{-1}} \quad (A6)$$

And the rate of return of total investment, from an impulse to public investment, r_2 , is the solution for:

$$(1 + r_2)^{20} = MPTI . \quad (A7)$$

Appendix 2.3.2. Data sources

Original series	Ameco codes
Gross Domestic Product at current market prices, thousands national currency.	1.0.0.0.UVGD
Price deflator of Gross Domestic Product, national currency, 1995 = 100.	3.1.0.0.PVGD
Gross fixed capital formation at current prices; general government, national currency.	1.0.0.0.UIGG
Gross fixed capital formation at current prices; private sector, national currency.	1.0.0.0.UIGP
Price deflator gross fixed capital formation; total economy, national currency; 1995 = 100.	3.1.0.0.PIGT
Nominal long-term interest rates - %	1.1.0.0.ILN
National consumer price index - 1995 = 100	3.0.0.0.ZCPIN
Current taxes on income and wealth (direct taxes); general government - National currency, current prices	1.0.0.0.UTYGF; 1.0.0.0.UTYG
Taxes linked to imports and production (indirect taxes); general government - National currency, current prices	1.0.0.0.UTVGF; 1.0.0.0.UTVG
Social contributions received; general government - National currency, current prices	1.0.0.0.UTSGF; 1.0.0.0.UTSG

Note: series from the EC AMECO database, April 2015.

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