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**Das Public Kapital:
How Much Would Higher German Public
Investment Help Germany and the Euro Area?**

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European Department

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Abstract

Given the backdrop of pressing infrastructure needs, this paper argues that higher German public investment would not only stimulate domestic demand in the near term and reduce the current account surplus, but would also raise output over the longer-run as well as generate beneficial regional spillovers. While time-to-build delays can weaken the impact of the stimulus in the short-run, the expansionary effects of higher public investment are substantially strengthened with an accommodative monetary policy stance—as is typical during periods of economic slack. The current low-interest rate environment presents a window of opportunity to finance higher public investment at historically favorable rates.

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EXECUTIVE SUMMARY

The recovery in the euro area is slow and tentative, and even growth in Germany seems to have lost momentum recently. At the same time, estimates of German growth potential are not only low, but will increasingly come under pressure owing to rapid population aging.

In this context, this paper argues that higher German public investment would not only stimulate domestic demand in the near term, but would also raise domestic output over the longer-run and generate beneficial spillovers across the rest of the euro area.

While Germany is not widely seen as a country with deficient public infrastructure, the reality is that this has been a neglected area for some time, especially in the area of transport infrastructure where there are pressing needs that have been clearly identified (for example, owing to aging roadways). Therefore, the positive effect of greater public investment on German potential output is likely to be sizeable.

Using model-based simulations, this paper quantifies the domestic and spillovers effects associated with higher German public investment. The main results and policy implications include the following:

- An increase in German public investment stimulates domestic demand in the short run, but also durably raises output as it becomes productive public capital.
- For instance, a 4-year, $\frac{1}{2}$ percent of GDP increase in German public investment would yield a persistent increase in real GDP of $\frac{3}{4}$ percent.
- In addition, the beneficial regional spillovers associated with such a program can be sizeable.
- The domestic impact of higher German public investment and the associated spillovers are even larger if monetary policy remains accommodative—as is typical during periods of economic slack.
- For example, the same 4-year, $\frac{1}{2}$ percent of GDP increase in public investment would not only durably raise German GDP, but would also raise growth in the euro area, with peak effects on real GDP in Greece, Ireland, Italy, Portugal, and Spain (considered together), of $\frac{1}{3}$ percent, in the likely case that monetary policy remained accommodative.
- Even when subject to time-to-build delays, higher German public investment can be expansionary both domestically and abroad when monetary policy remains accommodative.

Taken together, it appears that the current low-interest rate environment presents a window of opportunity to finance higher efficient public investment projects at historically favorable rates.

I. INTRODUCTION

The euro area is experiencing a weak and uneven recovery. The euro area output gap remains large, and inflation is persistently below the ECB's price stability mandate. Within the euro area, the German economy—the largest in the currency union—seems to be losing momentum, despite the resilience of its labor market and its generally healthy balance sheets. At the same time, estimates of German growth potential are low amid increasingly intensifying demographic pressures and subdued investment (**Figure 1**).

There have been repeated calls for Germany to do more to boost domestic demand and thereby bolster euro area growth. But are there policies which can increase German growth durably in ways that also support the euro area recovery? Would higher German public investment help? If yes, to what extent?

Kaput Public Kapital?

Although Germany is not widely seen as a country with deficient public infrastructure, the reality is that this has been a neglected area for some time. Public investment in Germany is the second lowest in the OECD (1.5 percent of GDP), while net public investment has been negative since 2003 as shown in **Figure 2**.¹ In fact, the average ratio of net government investment-to-net domestic product over the last decade was -0.2 percent, which has been associated with a deterioration of the public capital stock.²

There is an active debate in the literature on the extent to which public investment affects the economy, particularly in the short run:

- On one side of the debate, a number of studies show that higher government investment stimulates domestic demand in the short run, but also raises output over the longer term as it becomes productive public capital (see, for example, Baxter and King, 1993). Moreover, there are many empirical studies supporting the notion that higher public investment can durably support growth (for a survey of the literature, see Bom and Ligthart, 2013).
- On the other side of the debate, Leeper and others (2010) first argue that government investment is subject to implementation and time-to-build delays. Then, using a model (which does not consider the role of monetary policy) they present simulations which

¹ At the same time, business executives' assessment of the overall quality of infrastructure has been declining for Germany (IMF, 2014).

² Recall that net domestic product (NDP) equals the gross domestic product (GDP) minus depreciation on a country's capital goods. Similarly, net investment is gross investment less depreciation. Therefore a negative rate of net investment implies a depletion in the stock of capital. Using the recently released ESA 2010 national accounts statistics conveys broadly similar patterns as those conveyed by the ESA 1995 series used here: for example, the average net government investment-to-net domestic product ratio since 2004 is still negative.

suggest that such delays can produce negative short-run output responses to increases in government investment.

Leaning towards the former side, the G20 and key policymakers across Europe have identified infrastructure investment as a policy priority.³ In Germany, several studies, including Bach and others (2013) and Zeuner (2013) have argued that there are pressing infrastructure needs, particularly in the areas of transportation (for example, owing to aging bridges and roadways).⁴ A common conclusion across these studies is that (i) increased public investment can raise German growth, and (ii) that Germany has the financial resources to finance such a program without jeopardizing its fiscal rules.

These studies, however, do not consider the relationship between public investment and monetary policy. For instance, to help counteract the Great Recession, the American Recovery and Reinvestment Act (a \$787 billion program, corresponding to over 5 percent of GDP, which included a sizeable allotment to infrastructure) was signed into law in February of 2009. Recall, however, that beginning in August 2007, the Federal Reserve had already cut interest rates by over 500 basis points and that the lower interest rate bound was reached in January 2009 (**Figure 3**). While the European case is complicated by the debt crisis, there are nonetheless similarities: The ECB cut rates by 325 basis points from September 2008, which had reached 1 percent in May 2009. As a response to the Great Recession, during January 2009, Germany initiated a large fiscal stimulus program (“Stimulus Package 2”, approximately 2.3 percent of GDP). Taken together, these two examples highlight that fiscal stimulus packages with a sizeable public investment element tend to be associated with a very accommodative monetary policy stance. Therefore, to get a more accurate assessment of the impact of higher public investment on growth, it seems imperative to consider the role of monetary policy.

The main goal of this paper is to quantify the domestic and euro area-wide macroeconomic consequences of greater public investment in Germany with and without monetary

³ Recent examples include the European Commission President Jean-Claude Juncker’s call for a €300 billion investment program (July 2014), Polish Minister of Finance Mateusz Szczurek’s proposal of a temporary €700 billion investment fund (September 2014), or the proposal by Bruegel Director Guntram Wolff for a two-year €400 billion public investment program, funded by the EIB bonds (October 2014).

⁴ Various studies place public infrastructure needs in transport alone at 0.2–0.4 percent of GDP per year, particularly owing to aging bridges and roadways. Estimates by the Cologne Institute for Economic Research (IW) suggest transport infrastructure needs of around €4 billion per year, while the “Daehre Commission Report” suggests a minimal need of €7.2 billion. The think tank DIW reports an estimate of around €10 billion per year (including pent-up needs) for maintenance and extension of the transport network. More generally, schools and kindergartens, particularly at the municipal level, represent other examples of infrastructure backlogs. Indeed, KfW surveys indicate a perceived municipal investment backlog of over €100 billion, of which transport (€27–31 billion), schools (€24–27 billion), and public administration buildings (€11 billion) comprise the largest needs. Relatedly, IW estimates needs of €120 billion over the next decade, split evenly between transport (already noted above), broadband communications network, and the energy sector (with the latter in the mostly in the purview of the private sector).

accommodation. In what follows, monetary policy is said to be accommodative when the nominal policy rate is constant—which is typically the case during periods of economic slack—and does not rise even if inflation increases (above target).

This paper uses a structural model to provide quantitative insights. Simulations are generated using a realistically calibrated multi-country general equilibrium model that is designed to address fiscal policy issues. In particular, a six-region, extended version of the IMF’s GIMF model is used to quantify the domestic and spillovers effects associated with higher German public investment (possibly subject to implementation and time-to-build delays) with and without monetary accommodation.

Model-based simulations yield several results with the following policy implications:

- In contrast with an increase in public consumption, an increase in German public investment raises domestic GDP more durably. A higher stock of public capital not only raises GDP in its own right, but by increasing the productivity of other factor inputs, it fosters higher private investment and employment, thereby further raising output.
- The beneficial spillovers associated with higher German public investment can be sizeable, while those associated with public consumption are limited. In particular, spillovers transmitted via the trade channel are stronger in the case of higher public investment.
- The domestic impact of higher German public investment and the associated spillovers are even larger if monetary policy remains accommodative. With an accommodative monetary stance, constant euro area nominal policy rates and higher rates of inflation yield lower real interest rates. This not only boosts domestic demand across the euro area, but also raises net exports owing to the attendant (real) exchange rate depreciation (vis-à-vis the rest of the world).
- Even when subject to time-to-build delays, higher German public investment is expansionary both domestically and abroad when monetary policy remains accommodative, the more realistic case if the public investment program is implemented during periods of economic slack.
- In this context, the current low-interest rate environment presents a window of opportunity to finance higher investment at historically favorable rates.

This paper extends the existing literature on the effects of countercyclical fiscal policy as follows:

- It jointly considers: (i) the implications of higher public investment—potentially subject to implementation delays; (ii) in a multi-country modeling framework; (iii) with non-Ricardian households; and (iv) with a clear role for countercyclical monetary policy. As discussed in

greater detail below, with the incorporation of these features, this paper offers an alternative perspective to some of the key results found in other studies.

- While many studies investigate the topic of fiscal stimulus, they typically concentrate on government consumption (Farhi and Werning, 2012; Elekdag and Muir, 2013; Blanchard and others, 2014). In contrast, Baxter and King (1993) consider the implications of government investment, and Leeper and others (2010) contribute to the literature by investigating the role of implementation delays for building public capital. However, in both studies Ricardian equivalence holds and their closed economy models do not allow for an assessment of spillovers. Gali and others (2007) break Ricardian equivalence by introducing hand-to-mouth (or LIQ households), but again in a closed economy framework.
- In contrast to many studies in the literature, this paper also uses a multi-country model to provide more refined quantitative spillovers estimates. This is important because spillovers can be transmitted via (or be influenced by developments) in third countries. Blanchard and others (2014) consider a two-country model comprising the core and stressed euro area (EA) countries. However, such a model is not able to fully capture how EA real exchange rate fluctuations vis-à-vis the rest of the world—possibly owing to changes in monetary policy—influence spillovers.
- This paper also considers the interaction between fiscal and monetary policy. In particular, the role of fiscal policy under monetary accommodation is explored, in the spirit of some other studies. For example, there are papers that consider fiscal policy (in New Keynesian models) in liquidity traps including Christiano and others (2011), Eggertsson (2011), and Woodford (2011), showing the fiscal multipliers can be large at the zero lower bound. Relatedly, Corsetti and others (2011), Nakamura and Steinsson (2011), and Erceg and Linde (2012) show that fiscal multipliers are generally higher under fixed exchange rate regimes in contrast to flexible ones echoing the intuition from a textbook Mundell-Flemming framework. In addition, the qualitative analysis of Farhi and Werning (2012) shows that the pattern of spillovers switches sign from negative in normal times when the currency union monetary authority raises interest rates to positive in a liquidity trap. Devereux and Cook (2011) and Fujiwara and Ueda (2013) focus on an environment with flexible exchange rates, and argue that a country expanding fiscal spending is likely to cause its currency to depreciate enough to generate negative spillovers to its trading partners.⁵

The rest of the paper is organized as follows. The next section presents an overview of the structural model used to generate the simulations which underpin the policy implications. The focus is on presenting the intuition behind the dynamics of the model. Section III discusses the

⁵ While we touch upon coordinated public investment expansions, and a role for monetary policy, optimal fiscal policy (for example, Gali and Monacelli, 2008), optimal fiscal and monetary policy coordination (for example, Schmitt-Grohe and Uribe, 2004), and/or (optimal) policy coordination (for example, Blanchard and others, 2014) are beyond the scope of this paper.

main quantitative results of the paper, including the assessment of their robustness to alternative assumptions. The final section concludes.

II. MODEL OVERVIEW

In this section, an overview of the modeling framework is presented. Key equations, parameter calibration, and the main channels through which spillovers are effected are discussed to highlight the intuition of the model.

GIMF is a multi-region dynamic stochastic general equilibrium (DSGE) model.⁶ A few features of the model are especially noteworthy:

- There are two types of households, both of which consume goods and supply labor. First, there are overlapping-generation households (OLG) that optimize their borrowing and saving decisions over a 20-year planning horizon. Second, there are liquidity-constrained households (LIQ), who do not save and have no access to credit. Intuitively, as the share of LIQ households increases, fiscal policy (for example, higher public investment) would be expected to be more potent in the short run, as these households consume all of their current income.
- Along with OLG and LIQ households, other frictions such as sticky prices and wages imply an important role for monetary and fiscal policy in economic stabilization.
- Together with private capital and labor, firms use public capital for production purposes. This paper also extends GIMF to allow for implementation delays for building public capital as discussed in greater detail below.
- This version of GIMF comprises six regions: Germany (DEU), “Stressed euro area countries” (Greece, Ireland, Italy, Portugal, and Spain), henceforth, “SE”, other euro area countries (“OEA”), the United States (US), Emerging Asia (EMAS), and the rest of the world (ROW).

In sum, GIMF combines four broad features allowing it to subsume most other models in the literature (including, for example, Leeper and others, 2010), but differentiate its results: (i) non-Ricardian households; (ii) productive public capital (potentially subject to implementation delays); (iii) a clear role for monetary policy; and (iv) in a multi-country framework.

⁶ For further details, see Kumhof and others (2010), Anderson and others (2013), and Elekdag and Muir (2013).

Production

This paper focuses on the role of government investment and productive public capital. Indeed, firms use public infrastructure (which is the government capital stock) along with private capital and labor for production. A simplified version of the production function is shown below:

$$Y_t = Z_t K_{t-1}^\zeta L_t^{(1-\zeta)} (K_{t-1}^G)^{\alpha_{KG}}$$

As in Baxter and King (1993), Glomm and Ravikumar (1997), and Leeper and others (2010), an increasing returns to scale with respect to productive public capital is assumed. A higher stock of public capital not only raises the level of output in its own right, but by raising the marginal productivity of other inputs, it also crowds in private capital and labor. The elasticity of output with respect to public capital determines the strength of this mechanism and is guided by the parameter α_{KG} . The output elasticity of public capital is conservatively set to 0.10 in line with Ligthart and Suarez (2011), in contrast to values ranging from 0.05 to 0.40 with an average greater than 0.2 used elsewhere in the literature (Aschauer, 1989; Baxter and King, 1993, Glomm and Ravikumar, 1997).

Capital accumulation

The process guiding private-sector capital accumulation is standard. Abstracting from adjustment costs, capital utilization, and other refinements, a simplified representation of the law of motion for private capital is as follows:

$$K_{t-1} = (1 - \delta)K_{t-2} + I_{t-1}$$

In contrast to the private sector, public capital accumulation allows for implementation delays. The process guiding government investment spending affects the dynamics of fiscal policy in important ways. GIMF is extended such that government investment is transformed into public capital through a time-to-build process, reflecting the lags between project initiation and completion that are observed in reality. Many projects, especially infrastructure, require coordination among federal, state, and local governments and have to go through a long process of planning, bidding, contracting, construction, and evaluation. While the legislature enacts appropriation bills to provide funding for government investment spending, it is often the case for public spending projects that the proportion of investment that occurs each period is less than what is authorized. In fact, the amount of government investment authorized can often deviate substantially from contemporaneous outlays, even for some projects which are claimed to be “shovel ready.” As in Leeper and others (2010), this modeling approach differs from most other papers in the literature which typically assume that authorized spending is immediately implemented and is immediately productive.

The dynamics of public-sector capital accumulation differs from that of the private sector. The following equations captures the time-to-build assumption in the spirit of Kydland and Prescott (1982):

$$K_{t-1}^G = (1 - \delta_G)K_{t-2}^G + A_{t-N-1}$$

$$G_t^I = \sum_{n=0}^{N-1} \varphi_n A_{t-n}$$

$$\sum_{n=0}^{N-1} \varphi_n = 1$$

Note that G_t^I is *implemented* government investment, which is different from *authorized* government investment, A_t . The law of motion for public capital takes a more familiar form when $N=1$, that is only a one-period delay, as is typically assumed in the literature (and the case for the private sector). Consistent with Leeper and others (2010), a three-year (time-to-build) lag is assumed ($N=3$), which implies that in the case the government authorized funding at time $t-3$ for a bridge, it would take three years until it can be used in production. A fraction of the authorized outlays occurs every period according to a sequence of spending rates denoted with the parameter φ_n . Again, in line with Leeper and others (2010), with $N=3$, the spending rates take on the following values: $\varphi_0=0$ (reflecting delays characterized by planning, bidding, and contracting are serves to capture implementation delays) and $\varphi_1=\varphi_2=1/2$. Continuing with the bridge example, while the bridge cannot be used for three years, government investment nonetheless increases during the time construction is underway (providing a bit of stimulus in the short run, but less than in the case where $N=1$, the standard convention in the literature).

The intuition behind these assumptions can be roughly summarized as follows: In contrast to the benchmark model, implementation (time-to-build) delays for building public capital has two implications: First, the short-run fiscal impulse is smaller (depending on parameterization of φ_n) as implemented investment is less than what is authorized. Second, the economy will not benefit from a higher stock of public capital in the short run and the beneficial crowding in affects associated with an increase in private capital and employment in the short run. In addition, public capital is presumed to depreciate at a slower pace than private capital (4 percent versus 10 percent depreciation per year), presenting another dimension whereby a higher stock of public capital durably raises output.

A textbook aggregate supply-aggregate demand framework helps the contrast of the macroeconomic implications of public consumption with public investment, including in the

case with implementation delays. As shown in **Figure 4**, the long-run aggregate supply (LRAS), short-run aggregate supply (SRAS), and the aggregate demand (AD) curves are in equilibrium with the prevailing price level \bar{P} and potential GDP of \bar{Y} .

- A fiscal stimulus in the form of a temporary increase in government consumption shifts the AD curve outward with an attendant increase in prices and output owing to higher domestic demand and is consistent with the standard textbook narrative.
- In the case of higher government investment, in addition to the AD shift, both of the AS curves also moves outward as the stimulus results in a higher stock of productive public capital (which raises potential output also reflecting the crowding in of other factors of production). Recall that a higher stock of public capital not only raises the level of output in its own right, but by raising the marginal productivity of other inputs, it also crowds in private capital and employment—in what follows, this mechanism will occasionally be referred to as the supply response associated with a higher stock of public capital. In this case, while the increase in real GDP is much larger, the price level remains flat (because of the supply response associated with a higher stock of productive public capital).
- With implementation (time-to-build) delays, the shift in the AS curves occur only gradually as higher government investment does not lead to an immediate increase in the stock of public capital. Therefore the short-run impact of higher public investment is mostly reflected as an increase of aggregate demand. The longer-run impact on real GDP is the same, however, as in the case without implementation delays.

Fiscal and Monetary Policy

Fiscal policy can be conducted in the model by using a variety of expenditure and tax instruments. For example, government spending may take the form of either consumption or investment expenditure, or lump-sum transfers to either all households or targeted towards specific households (LIQ or OLG). Revenue accrues from the taxes on labor and corporate income, consumption taxes, and (non-distortionary) lump-sum taxes. Government investment spending augments public infrastructure, which depreciates at a constant rate over time (but at a slower pace than that of private capital). Recall that fiscal policy plays an important role in economic stabilization because of LIQ and OLG households which break Ricardian equivalence implying non-neutrality in both spending- and revenue-based fiscal policies.

Fiscal policy is underpinned by two key equations:

- The first is the definition of the fiscal deficit, a consequence of the government budget constraint. In particular, higher public investment, for example, could be financed through a combination of increasing the deficit (implying a higher stock of debt), raising taxes (consumption, labor, and/or capital), or by cutting transfers and government consumption.

Note that while the benchmark simulation initially considers a deficit-financed increase in German public investment, other financing options are also considered below.

$$GDEF_t = G_C + G_I + TRAN + INT - TAX$$

- The second equation is the fiscal rule. In this case, transfers adjust (usually after the initial fiscal impulse) so that the deficit (-to-GDP ratio) gradually reaches its target. This path is determined by the degree of automatic stabilization (as determined by ω_{gap} and the size of the output gap) and the debt gap (along with ω_{debt}).

$$gdefrat_t = gdefrat_t^* + \omega_{gap} gap_t + \omega_{debt} (D_t - D_t^*)$$

Monetary policy is guided by a standard interest rate reactions function. In the case of Germany, for example, monetary conditions are determined by the euro area nominal policy rate which responds to the aggregate inflation rate for the currency union. A simplified version of the interest rate rule is as follows:

$$i_t^{EA} = \rho i_{t-1}^{EA} + (1 - \rho) [\delta_\pi (\pi_t^{EA} - \pi_t^*)]$$

Euro area (EA) monetary policy affects not only domestic demand via changes in the interest rate, but—given the multi-region setup of GIMF—also net exports through its influence on the currency union’s real effective exchange rate. Monetary accommodation is achieved by holding the nominal policy rate fixed for a selected number of years.

Model Calibration

This section focuses on how trade ties across the regions are calibrated. Although the details are relegated to the Appendix, note that national accounts are used to pin down key steady-state ratios, for instance, and many other parameters are standard with those in the literature (along with the papers already cited, see, for example, Elekdag and Muir, 2013; and Kumhof and others, 2010).

The model is calibrated to realistically account for trade linkages across regions. All bilateral trade flows are explicitly modeled, as are the relative prices for each region, including exchange rates. There is trade in both intermediate and final (consumption and investment) goods in GIMF. A summary of the trade matrix is shown in **Table 1**, which highlights some key facts:

- Germany is very open, especially for such a large economy.
- However, while Germany is large (accounting for roughly one third of EA GDP), so are the other regions (OEA includes France and the Netherlands; SE includes Italy and Spain).
- While Germany imports a substantial share of goods and services from OEA, imports from SE are much smaller. That is, the direct trade linkages between Germany and the SE are relatively weak.
- Moreover, Germany's indirect trade linkages via third countries, including the OEA—which are explicitly captured in the model—are also weak (OEA imports from the SE are small).
- This six-region version of GIMF also accounts for trade with the rest of the world, accounting for close to 80 percent of global GDP. The transmission of shocks to and from this large block can be sizeable, highlighting the importance of multi-country models in terms of providing more refined spillover estimates.⁷

Spillovers

Spillovers are transmitted via several channels:

- ***Trade channel:*** Fiscal stimulus leading to higher German output raises import demand which implies positive spillovers to its trading partners. The strength of this channel hinges critically on the share of German imports from the specific trading partner. Given the larger import share from the OEA relative to SE, intuitively, spillovers via the trade channel would be stronger for the former.
- ***Exchange rate channel:*** At the same time, the positive German output gap yields a higher inflation rate relative to the rest of the currency union, and thereby associated with a real *effective* exchange rate (REER) appreciation. The implied REER depreciation in the rest of the euro area stimulates exports in the OEA and SE contributing the higher output.

Spillovers are influenced by the prevailing monetary conditions:

⁷ In GIMF, similar to private spending, the government consumes the aggregate consumption good. As a departure from some other studies, this implies that private and public consumption have the same import content (in contrast to the data which indicate that private consumption has a higher import content than that of public consumption). This is also the case for investment. While these shares are consistent with Blanchard and others (2014) for example, this feature biases the regional spillovers upwards to a certain extent. Future versions of GIMF could be further refined in this regard.

- **Monetary policy channel:** The monetary stance will tighten given the prevailing higher inflation rates across Germany, OEA, and the SE, leading to higher real interest rates across the monetary union. This will depress domestic demand across the EA, but will also be associated with an appreciation of the REER vis-à-vis the rest of the world, thereby depressing EA exports. Depending on the nature of the fiscal stimulus, the monetary tightening can dampen or even overwhelm first two channels (trade and exchange rate), such that higher German government consumption, for example, actually implies negative growth spillovers to the OEA or the SE. Taken together, monetary policy can result in negative spillovers to the rest of the region in the context of a German fiscal stimulus.
- **Monetary accommodation:** However, if instead, the monetary stance is accommodative this would strengthen the positive spillovers triggered by a German stimulus. Specifically, with constant nominal policy rates, higher inflation rates are characterized by lower real interest rates boosting domestic demand in the region, while the attendant REER depreciation (vis-à-vis the rest of the world) would increase the growth contribution from net exports. In turn, higher domestic demand not only strengthens the trade channel, but by putting upward pressure on prices, further depresses real interest rates, generating a virtuous growth *feedback* mechanism.

Spillovers vary depending on the type of fiscal stimulus:

- **Government investment:** In contrast to higher public consumption, German fiscal stimulus in the form of higher government investment yields greater regional spillovers. This is because greater government investment is assumed to culminate in a higher stock of productive public capital, which also crowds in other factors of production (namely private capital and employment). This *supply response*, provides an additional boost to real GDP, and strengthens the trade channel. It weakens the REER channel because of dampened inflationary pressures, but results in lesser degree of monetary tightening. In sum, the supply response characterized by higher public investment leads to stronger spillovers by strengthening domestic output while inflation remains broadly contained (thereby characterized by a less aggressive regional monetary policy stance). As before, monetary accommodation would strengthen the domestic and spillover effects associated with this type of stimulus.
- **Implementation delays:** When there are implementation delays for building public capital, while the medium- and longer-term implications are similar, the *short-run dynamics* of greater government investment differ.⁸ Specifically, in the short-run, higher public investment in the case with implementation delays resembles that of fiscal stimulus via

⁸ It is worthy to note that in the case of Germany, an important portion of the identified needs would involve maintenance and refurbishing of existing infrastructure, and therefore it could be argued that implementation and time-to-build considerations may be less binding than in the case of new projects.

government consumption. In other words, when subject to implementation delays, it is possible that higher public investment is associated with adverse short-run spillovers. However, the stimulative impulse of monetary accommodation counteracts these short-run contractionary effects.⁹

III. RESULTS

This section presents the main results underpinning the policy implications of the paper. Different forms of German fiscal stimulus are analyzed—with a focus on greater public investment possibly subject to implementation delays—with and without monetary accommodation. Various financing instruments, differing speeds of debt stabilization, policy coordination, and other robustness exercises are also considered.

Higher Government Consumption

Higher German public consumption results in a short-lived increase in domestic activity, but negligible regional spillovers. **Figure 5** summarizes the impact of a 1 percent of GDP, 2-year (that is, 1 percent of GDP per year), debt-financed increase in German government consumption on real GDP (as a percent deviation from the baseline) and the current account balance (as a percent of GDP, difference from baseline) in Germany, SE (the “stressed economies,” namely, Greece, Ireland, Italy, Portugal, and Spain) and OEA (other euro area economies). It is important to note that the 2-year, 1 percent of GDP shocks are considered to facilitate comparison with other studies, including, for example, Elekdag and Muir (2013). As discussed below, a ½ percent of GDP, 4-year shock could also be considered and would comply with Germany’s fiscal rules. Higher government consumption increases aggregate demand, yielding a positive output gap and higher domestic as well as regional inflation rates (**Figure 6**). Nominal, and thereby real interest rates (given stick prices) increase as monetary policy tightens in response to higher inflation rates across the currency union. While the extent and timing differs across the region, higher real interest rates and the attendant appreciation of the real effective exchange rate (REER) counteract the beneficial effects of the stimulus on domestic activity and also weaken the associated spillovers. While the current account (CA) balances of OEA and SE improves slightly, the German CA balance deteriorates reflecting a greater demand for imports and lower exports associated with the appreciation of the REER.

Higher Government Investment

In contrast to other forms of fiscal stimulus, higher German public investment holds the most promise for durably raising real GDP. In contrast with an increase in public consumption, an increase in public investment raises productive capacity more durably as it adds to the

⁹ As discussed below, spillovers are also strengthened as the duration of monetary accommodation increases, if inflation is more responsive (steeper price and wage Phillips curves as noted in Blanchard and other, 2014, but not explored here), or if public capital is assumed to be more or less productive.

government stock of capital (**Figure 5**). Therefore, it raises the marginal productivity of other inputs, crowding in private capital and labor, and this additional supply response further contributes to the persistent rise of real GDP. Moreover, despite a higher level of output, inflationary pressures are contained because of the supply response characterized by a higher stock of productive public capital which limits the degree of monetary tightening (**Figure 7**). Taken together, the simulations suggest that German real GDP rises by 1 percent and 0.6 percent relative to baseline (in year two) in response to the public investment or public consumption increases, respectively. The peak impact (in year two) on the German current account, at around 0.6 percentage points, is more modest and similar for the two policy experiments.

The beneficial spillovers associated with higher German public investment can be meaningful, while those associated with public consumption are limited. Comparing the two types of stimuli also makes it clear that higher German public investment has greater growth spillovers than higher public consumption (**Figure 5**, **Figure 6**, and **Figure 7**). Specifically, the peak effect is higher GDP of 0.22 and 0.13 in OEA and SE, respectively, in the case of the public investment stimulus, in contrast to negligible increases in the case of public consumption. This reflects the stronger and more persistent effect of public investment on Germany's aggregate demand and real GDP, as well as the more limited effects on EA inflation—and thereby less monetary tightening by the ECB. Both effects strengthen the trade and monetary policy channels through which spillovers are transmitted across the EA. While the model treats the SE as a group, effects vary depending on, *inter alia*, the strength of the trade linkages with Germany, implying larger spillovers to Italy, for example. Spillovers on the current account balance in the SE, however, are smaller regardless of the policy.

Accommodative Regional Monetary Policy

The domestic impact of a German fiscal stimulus and the associated spillovers are larger if monetary policy remains accommodative, especially in the case of public investment. The model assumes that before the policies are implemented the economy is operating at full capacity—that is, the output gap is zero. Thus, any policy experiment that leads to an expansion of aggregate demand in the EA leads to an increase in inflation, triggering a tightening of monetary policy because of the central bank's reaction function (the ECB has a price stability objective). However, in the present circumstances, in which there is a sizable negative output gap in the EA and the ECB stance is constrained by the zero lower bound, it may be more plausible to assume that a German fiscal stimulus will not cause a monetary tightening immediately. Accordingly, the simulations are repeated with policy rates kept unchanged for two years, that is, monetary policy remains accommodative and summarized in **Figure 8** (see also **Figure 9** and **Figure 10**). The result is that the positive effect of higher public investment on growth in Germany, OEA, and SE is larger, because of the lower prevailing real interest rates (1.05, 0.30, and 0.20 percent, respectively).

Regional spillovers from higher German public investment could be even larger if there is a credit crunch in the stress EA economies. While regional financing conditions have generally

improved more recently, household access to credit is still tight and corporate spreads are still relatively high. To explore the consequences of “credit crunch” on spillovers, the baseline increase in German government investment is simulated mainly through a higher share of LIQ households in OEA and SE (40 percent versus the baseline of 25 percent). In such an environment (a mild “credit crunch”), spillovers are larger, including when monetary policy is accommodative (**Figure 11**). In this illustrative scenario, higher growth triggered by the German stimulus increases the current income and therefore the short-run consumption of a larger share of OEA and SE households, thereby generating an even larger increase in output in these regions.

Robustness

These findings are robust to alternative model parameterizations. The elasticity of output to the stock of public debt, α_{KG} , is a key parameter determining the extent to which public capital is productive. To assess the robustness of the findings above, an increase in public investment is simulated under two alternative parameterizations: $\alpha_{KG} = 0.05$ (as in Baxter and King, 1993; and Leeper and others, 2010) or $\alpha_{KG} = 0.15$ which is more in line with the empirical literature surveyed by Ligthart and Suarez (2011) for example. As shown in **Figure 12**, with a higher (lower) value of α_{KG} , the domestic impact and spillovers characterized by an expansion of German government investment is larger (smaller).

The beneficial effects of greater public investment are amplified as the duration of monetary accommodation is prolonged. As summarized in **Figure 13**, a longer episode of monetary accommodation boosts the growth impact associated with higher public investment (as real interest rates are lower for longer in part because of forward-looking agents). This result is consistent with Anderson and others (2013) and Blanchard and others (2014). Intuitively, as the duration of the stimulus increases, so too does the attendant expansionary effects on growth. At the same time, as the duration of the fiscal stimulus increases, intuitively, so does the attendant expansionary effects on growth.

Other forms of fiscal stimulus

When compared to public investment, other forms of German fiscal stimulus are characterized with a smaller increase in real GDP. **Table 2** contrasts the output implications associated with a German fiscal stimulus implemented through various instruments including higher public consumption and investment, as discussed above, with higher transfers (general or targeted either to OLG or LIQ households) or lower taxes (VAT, labor, or corporate). Cuts in (distortionary) taxes seem to result in greater output gains than higher transfers, except when they are targeted towards LIQ households (who consume all of their disposable income). Monetary accommodation amplifies the expansionary effects of all forms of stimulus. Taken together, in contrast to other forms of stimulus, higher German public investment raises real GDP by the greatest extent, both domestically and across the rest of the euro area.

Implementation Delays

Implementation delays associated with higher German public investment postpone the eventual rise in real GDP. As shown in **Figure 14**, three shocks are considered: (i) the benchmark increase in German public investment; (ii) the same increase in public investment, but with implementation (time-to-build) delays; and (iii) a version with monetary policy accommodation (**Figure 15** and **Figure 16**). In contrast to the benchmark calibration, the short-run increase in real GDP is more gradual because of two reinforcing mechanisms: First, only a fraction of the authorized outlays gets spent per period—in fact, nothing gets spent in the first period. Therefore, the government absorbs fewer goods and services when there are implementation delays relative to the case without them. Second, it takes time to build up the stock of government capital. The first mechanism implies a weaker initial fiscal impulse, whereas the second means that the economy will not benefit from neither a higher stock of public capital in the short-run nor the beneficial crowding-in effects associated with the increases in private capital and employment. In parallel with the lagged completion of public capital (and the productivity benefits it confers to other factor inputs), the increase in private investment and employment are also delayed. In fact, similar to the findings of Leeper and others (2010), with implementation delays, higher public investment may even lead to a short-run contraction in domestic output. However, while the short-run implications differ depending on whether or not the simulations incorporate implementation delays, the longer-run output gains characterized by higher public investment are the same. A byproduct of implementation delays is a deferred and somewhat smoother deficit profile, implying less of an annual budgetary burden in the short run.

The Role of Monetary Policy Accommodation

Monetary accommodation counteracts any of the short-run contractionary effects characterized by higher public investment subject to implementation delays. As noted above, with implementation delays, the short-run stimulus from an increase in public investment temporarily suppresses German GDP (by -0.01 in the first period) thereby initially dampening the trade channel through which spillovers are transmitted across the region. At the same time, with implementation delays, EA inflation is higher in the short run (as German prices increase by more owing to the lack of an initial supply response), and is offset by a higher increase in EA nominal policy rates. The combination of a weaker short-run fiscal impulse and higher real interest rates suppresses activity across the EA. Therefore, the monetary policy channel would exacerbate the negative short-term demand spillovers (to Germany's main EA trading partners). However, with accommodative monetary policy, inflation rise markedly across the EA, yielding negative real interest rates, and thereby stimulating demand in Germany, SE, and OEA. Even with implementation delays, regional spillovers can be appreciable when monetary policy remains accommodative.

This key result provides an alternative perspective to some of the findings in other studies. For example, Leeper and others (2010) argue that implementation delays can produce small or even negative output responses to an increase in government investment in the short run. Indeed, this

paper replicates this finding (even with non-Ricardian households and a larger α_{KG} of 0.10 instead of 0.05). However, in contrast to their paper (which can not account for the role of monetary policy by construction given their closed-economy neoclassical growth model), this study finds that the aforementioned short-run contractionary effects can be overturned under monetary accommodation (this is not only true for the domestic economy, but also in terms of regional spillovers).

This result is important because fiscal stimulus packages with a sizeable public investment element tend to be associated with a very accommodative monetary policy stance. Recall that before the American Recovery and Reinvestment Act was enacted, the Fed had already cut interest rates by more than 500 basis points. Similarly, in Germany, by the time “Stimulus Package 2” was initiated, the ECB cut rates by 325 basis points from September 2008. Both of these examples demonstrate the fiscal stimulus packages containing large public investment programs occur in conjunction with monetary accommodation. Therefore, it may be misleading to assess the growth implications of higher public investment without taking into account monetary policy.

Robustness

These results are also robust to alternative calibrations of the model. As before, we simulate the increases in public investment subject to implementation delays using two different values of α_{KG} (0.05 or 0.15). As shown in **Figure 17**, the domestic short-run contractionary effect discussed above is more pronounced when $\alpha_{KG} = 0.05$, but is no longer present in the case when $\alpha_{KG} = 0.15$. Emphasizing the key finding above, monetary accommodation once again counteracts the adverse short-run spillovers even in the case of $\alpha_{KG} = 0.05$.

Financing

The positive effects of public investment on GDP would be smaller if the projects were financed by instruments other than debt. There are various ways to finance greater German public investment. Because public investment presumably would also benefit future generations, from an intergenerational equity perspective, it appears justified to finance these outlays partly via debt issuance. In addition, the current low-interest rate environment presents a window of opportunity to finance higher investment at historically favorable rates. Alternatively, higher government investment could be financed in a “budget neutral” manner by a combination of government consumption or transfer reductions, or through higher taxes. Simulations suggest that a budget neutral increase in public investment financed via higher taxes or lower transfers (less distortionary) are generally associated with the lowest and highest impacts on real GDP, respectively (**Table 3**).

Budgeting the Budget?

To comply with German fiscal rules, the expansion in public investment needs to be appropriately calibrated. The Medium-Term Objective (MTO) of the Fiscal Compact restrains the general government structural deficit to 0.5 percent of GDP and the German debt brake rule limits the central government's structural deficit to 0.35 percent of GDP beginning in 2016. To facilitate comparisons with other studies (for example, Elekdag and Muir, 2013), simulations have been presented using 1 percent of GDP, 2-year fiscal stimulus. Based on current fiscal projections, this would violate the MTO. However, a ½ percent of GDP, 4-year increase in public investment could be accommodated under the fiscal rules (**Table 3**). Such a program would yield a persistent increase in GDP of ¾ percent. The same 4-year, ½ percent of GDP program would also raise growth in the EA, with peak effects on real GDP in Greece, Ireland, Italy, Portugal, and Spain (considered together), of 0.3 percent, when monetary policy remains accommodative for four years.

Faster Debt Stabilization

A more rapid pace of debt stabilization need not necessarily suppress real GDP. The benchmark increase in public investment implies a higher stock of debt, which gradually returns back to its pre-stimulus level. The rate of debt stabilization can influence the impact of fiscal stimulus on growth. For example, in Leeper and others (2010), speeding up debt retirement brings forward the negative impact of distorting debt financing from raising tax rates or reducing government consumption. Therefore, retiring debt more quickly in their framework dampens the expansionary effects of government investment in the short-run. However, faster debt stabilization following an expansion of public investment can be achieved using instruments other than taxes. In **Figure 18**, following the benchmark increase in government investment, debt is reduced 30 percent faster by cutting (general) transfers. As is clear from the figure, in contrast to Leeper and others (2010), faster debt stabilization (achieved by reducing transfers) appears to have a negligible impact on real GDP. This is because of the small effects of greater government *non-distortionary* transfers on real GDP (recall Table 2). Intuitively, the composition of the fiscal adjustment matters.

Policy Coordination?

A concerted increase in public investment would raise regional output by an even greater extent. While a deeper investigation of policy coordination is beyond the scope of this paper, as a first pass, we consider the implications of higher public investment in Germany and the OEA.

Figure 19 summarizes the implications of higher public investment in (i) Germany (the benchmark); (ii) in OEA; as well as (iii) in Germany and OEA—that is, a coordinated fiscal stimulus. While the expansionary effects on output are larger when Germany and the OEA raise public investment jointly, note that the German current account balance does not deteriorate as much. This is because a sizeable share of the OEA stimulus is actually directed toward Germany, thus lifting its trade balance. In other words, a coordinated increase in public

investment could support the regional recovery to a greater extent, but may reduce the current account balances of surplus countries to a lesser degree.

IV. CONCLUDING REMARKS

The recovery in the euro area is slow and tentative, and even growth in Germany seems to have lost momentum recently. At the same time, estimates of German growth potential are not only low, but will increasingly come under pressure owing to rapid population aging.

In this context, this paper argues that higher German public investment would not only stimulate domestic demand in the near term, but would also raise domestic output over the longer-run and be associated with beneficial spillovers across the rest of the euro area.

While Germany is not widely seen as a country with deficient public infrastructure, the reality is that this has been a neglected area for some time, especially in the area of transport infrastructure where there are pressing needs that have been clearly identified (for example, owing to aging roadways). Therefore, the positive effect of greater public investment on German potential output is likely to be sizeable.

Using model-based simulations, this paper quantifies the domestic and spillovers effects associated with higher German public investment. Key findings and policy implications include the following:

- An increase in German public investment stimulates domestic demand in the short run, but also durably raises output as it becomes productive public capital. In addition, the beneficial regional spillovers associated with such a program can be sizeable.
- The domestic impact of higher German public investment and the associated spillovers are even larger if monetary policy remains accommodative—as is typical during periods of economic slack.
- Even when subject to implementation and time-to-build delays, higher German public investment can be expansionary both domestically and abroad, if there is monetary policy accommodation.

Taken together, it appears that the current low-interest rate environment presents a window of opportunity to finance higher efficient public investment projects at historically favorable rates.

REFERENCES

- Anderson, D., B. Hunt, M. Kortelainen, M. Kumhof, D. Laxton, D. Muir, S. Mursula, and S. Snudden, 2013, “Getting to Know GIMF: The Simulation Properties of the Global Integrated Monetary and Fiscal Model,” IMF Working Paper 13/55.
- Aschauer, D.A., 1989, “Is Public Expenditure Productive?” *Journal of Monetary Economics* Vol. 23, pp. 177-200.
- Bach, S., G. Baldi, K. Bernoth, J. Blazejczak, B. Bremer, J. Diekmann, D. Edler, B. Farkas, F. Fichtner, M. Fratzscher, M. Gornig, C. Kemfert, U. Kunert, H. Link, K. Neuhoff, W.-P. Schill, and C. K. Spiess, 2013, “Germany Must Invest More in Its Future,” DIW Economic Bulletin 08/2013.
- Blanchard, O., C.J. Erceg, and J. Linde, 2014, “Should the Core Expand Spending to Help the Periphery?” mimeo.
- Baxter, M., and R. G. King, 1993, “Fiscal Policy in General Equilibrium,” *American Economic Review*, Vol. 83, Issue 3, pp. 315–334.
- Bom, P.R.R. and J.E. Ligthart, 2013, “What have we learned from three decades of research on the productivity of public capital?” *Journal of Economic Surveys*, Vol. 0 (0), pp. 1–28
- Christiano, L. J., M. Eichenbaum, and S. Rebelo, 2011, “When is the Government Spending Multiplier Large?” *Journal of Political Economy*, Vol. 119(1), pp. 78–121.
- Coenen, G., C.J. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Lindé, A. Mourougane, D. Muir, S. Mursula, C. de Resende, J. Roberts, W. Roeger, S. Snudden, M. Trabandt, and J. in.t Veld, 2012, Effects of Fiscal Stimulus in Structural Models,” *American Economic Journal: Macroeconomics*, Vol. 4(1), pp. 22–68.
- Giancarlo C., A. Meier, and G.J. Mueller, 2012, “What Determines Government Spending Multipliers?” IMF Working Paper 12/150.
- Cook, D. and M. B. Devereux, 2011, “Optimal Fiscal Policy in a World Liquidity Trap,” *European Economic Review*, Vol. 55(2), pp. 443–62.
- Fujiwari, I. and K. Ueda, 2013, “The Fiscal Multiplier and Spillover in a Global Liquidity Trap,” *Journal of Economic Dynamics and Control*, Vol. 37, pp. 1264–83.
- Eggertsson, G.B, 2011, What Fiscal Policy is Effective at Zero Interest Rates? In *NBER Macroeconomics Annual*, Vol., D. Acemoglu and M. Woodford, eds. pp. 59–112, National Bureau of Economic Research
- Elekdag, S. and D. Muir, 2013, “Trade Linkages, Balance Sheets, and Spillovers: The Germany–Central European Supply Chain,” IMF Working Paper 13/263.
<https://www.imf.org/external/pubs/cat/longres.aspx?sk=40987.0>

- Elekdag, S. and D. Muir, 2014, “Which Policies Can Boost German Growth and Reduce the Current Account Surplus?” IMF Country Report No. 14/217 (Germany: Selected Issues) <http://www.imf.org/external/pubs/cat/longres.aspx?sk=41767.0>
- Erceg, C. and J. Lindé, 2013, “Fiscal Consolidation in a Currency Union: Spending Cuts vs. Tax Hikes,” *Journal of Economic Dynamics and Control*, Vol. 37, pp. 422–45.
- Farhi, E. and I. Werning, 2012, “Fiscal Multipliers: Liquidity Traps and Currency Unions,” NBER Working Paper No. 18381
- Galí, J., D. López-Salido, and J. Vallés, 2007, “Understanding the Effects of Government Spending on Consumption,” *Journal of the European Economic Association*, Vol. 5(1), pp. 227–70.
- Glomm, G, and B. Ravikumar, 1997, “Productive Government Expenditures and Long-Run Growth,” *Journal of Economic Dynamics and Control Dynamics*, Vol. 21, pp. 183–204.
- International Monetary Fund, 2014, *World Economic Outlook* (October); Washington.
- In’t Veld, J., 2013, “Fiscal Consolidations and Spillovers in the Euro Area Periphery and Core,” European Commission Economic Papers No. 506.
- Kydland, F.E. and E.C. Prescott, 1982, “Time to Build and Aggregate Fluctuations,” *Econometrica*, Vol. 50, No. 6, pp. 1345–70.
- Kumhof, D., D. Laxton, D. Muir, and S. Mursula, 2010, “The Global Integrated Monetary Fiscal Model (GIMF)—Theoretical Structure,” IMF Working Paper 10/34.
- Leeper, E.M., T.B. Walker, and S-C.S. Yang, 2010, “Government Investment and Fiscal Stimulus,” *Journal of Monetary Economics*, Vol. 57, pp. 1000–12.
- Ligthart, J.E., and M Suarez, 2011, “The Productivity of Public Capital: A Meta-Analysis,” in W. Jonkhoff and W. Manshanden (Eds.), *Infrastructure Productivity Evaluation*, pp. 5–33, New York: Springer-Verlag. (Springer Briefs in Economics Series, 1).
- Nakamura, E. and J. Steinsson, 2011, “Fiscal Stimulus in a Monetary Union: Evidence from U.S. Regions,” NBER Working Paper 17391
- Schmitt-Grohe, S. and M. Uribe, 2004, “Optimal Fiscal and Monetary Policy Under Sticky Prices,” *Journal of Economic Theory*, Vol. 114, pp. 198–230.
- Woodford, M., 2011, “Simple Analytics of the Government Expenditure Multiplier,” *American Economic Journal: Macroeconomics*, Vol. 3(1), pp. 1–35.
- Zeuner, J., 2013, “Investing for the future,” KFW Focus on Economics, No. 21 (May).

Table 1. Summary of the Trade Matrix
 (Imports in percent of nominal GDP unless otherwise noted)

	Germany	OEA	GIIPS
Total imports	47.7	38.1	29.7
from Germany	—	10.0	4.3
from OEA	17.0	—	6.3
from GIIPS	4.5	5.0	—
Size (Percent of world GDP)	5.1	7.3	6.4

Source: IMF Direction of Trade; United Nations ComTrade; and authors' calculations.

Note: OEA and GIIPS denote "other euro area" countries and the aggregation of Greece, Ireland, Italy, Portugal, and Spain, respectively.

Table 2. Other Forms of German Fiscal Stimulus

(Deviation from baseline)

	Real GDP			Current account		
	(Percent)			(Percentage points)		
	Germany	Other EA	GIIPS	Germany	Other EA	GIIPS
Government investment	0.99	0.22	0.13	-0.57	0.12	0.05
Government consumption	0.55	0.09	0.02	-0.52	0.19	0.04
Transfers:						
General	0.09	0.01	-0.01	-0.11	0.02	0.01
OLG	0.02	0.00	-0.01	-0.04	0.01	0.00
LIQ	0.31	0.04	-0.01	-0.31	0.05	0.02
Taxes:						
VAT	0.22	0.03	-0.01	-0.22	0.04	0.02
Labor	0.22	0.03	0.02	-0.07	0.02	0.01
Corporate	0.16	0.03	0.01	-0.16	0.03	0.01
With monetary accomodation:						
Government investment	1.05	0.30	0.20	-0.57	0.12	0.05
Government consumption	0.64	0.18	0.09	-0.52	0.19	0.04
Transfers:						
General	0.11	0.02	0.01	-0.11	0.02	0.01
OLG	0.02	0.00	0.00	-0.05	0.00	0.00
LIQ	0.37	0.09	0.04	-0.31	0.05	0.02
Taxes:						
VAT	0.26	0.06	0.03	-0.22	0.04	0.02
Labor	0.20	0.01	0.00	-0.07	0.02	0.01
Corporate	0.19	0.06	0.04	-0.14	0.03	0.01

Source: Authors' calculations

Table 3. Higher German Public Investment: Financing Options

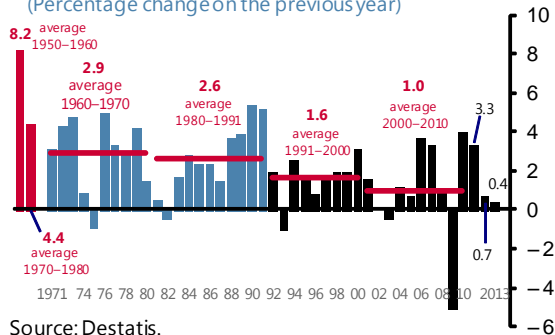
(Deviation from baseline)

	Real GDP (Percent)			Current account (Percentage points)		
	Germany	Other EA	GIIPS	Germany	Other EA	GIIPS
Debt-financed policies:						
Government Investment (GI)	0.99	0.22	0.13	-0.57	0.12	0.05
GI spread over 4 years	0.52	0.11	0.06	-0.36	0.06	0.03
<i>with monetary accommodation (MA):</i>						
GI	1.05	0.30	0.20	-0.56	0.13	0.06
GI spread over 4 years, 2-year MA	0.63	0.25	0.17	-0.36	0.07	0.04
GI spread over 4 years, 4-year MA	0.73	0.35	0.30	-0.35	0.22	0.11
Budget neutral policies:						
GI offset with changes to:						
Government consumption	0.53	0.13	0.11	-0.08	0.03	0.02
<i>Transfers:</i>						
General	0.91	0.22	0.14	-0.48	0.10	0.04
OLG	0.98	0.23	0.14	-0.54	0.11	0.05
LIQ	0.71	0.19	0.13	-0.30	0.07	0.03
<i>Taxes:</i>						
VAT	0.78	0.20	0.13	-0.38	0.08	0.04
Labor	0.77	0.19	0.11	-0.51	0.10	0.04
Corporate	0.84	0.19	0.12	-0.42	0.09	0.04
Source: Authors' calculations						

Figure 1. Germany: Stylized Facts

Germany: Real GDP Growth

(Percentage change on the previous year)

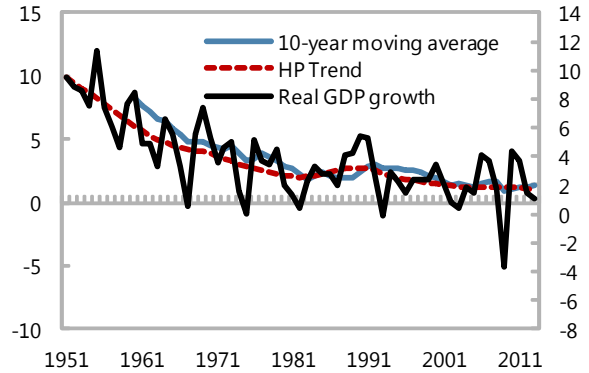


Source: Destatis.

Note: For German growth, there are methodological differences over time, see Destatis for details. ESA 1995 data used for national accounts.

Germany: Real GDP Growth

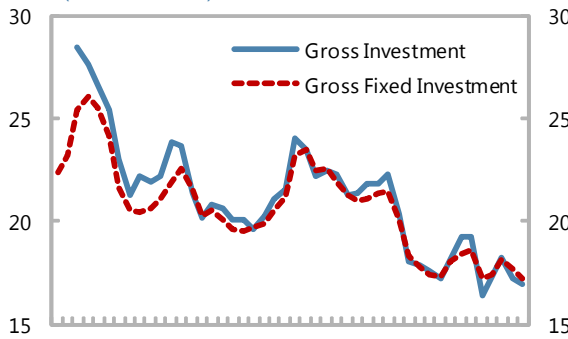
(Percent)



Sources: Destatis and authors' calculations.

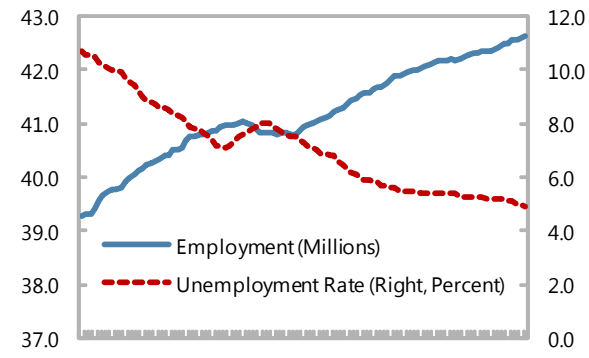
Germany: Investment-to-GDP Ratios

(Percent of GDP)



Sources: Haver Analytics and authors' calculations.

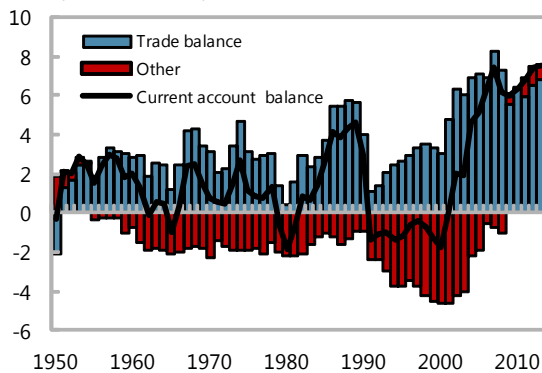
Germany: Labor Market Indicators



Sources: Haver Analytics and authors' calculations.

Germany: Current Account Balance

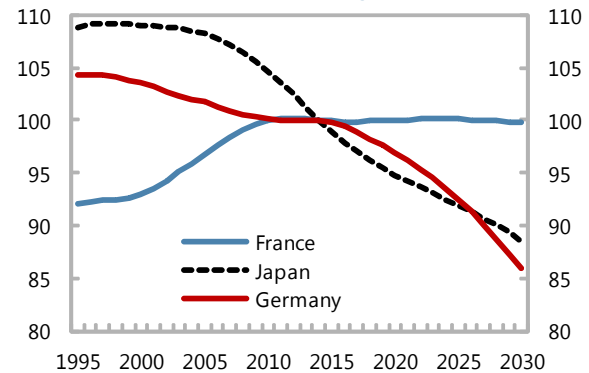
(Percent of GDP)



Sources: Bundesbank and authors' calculations.

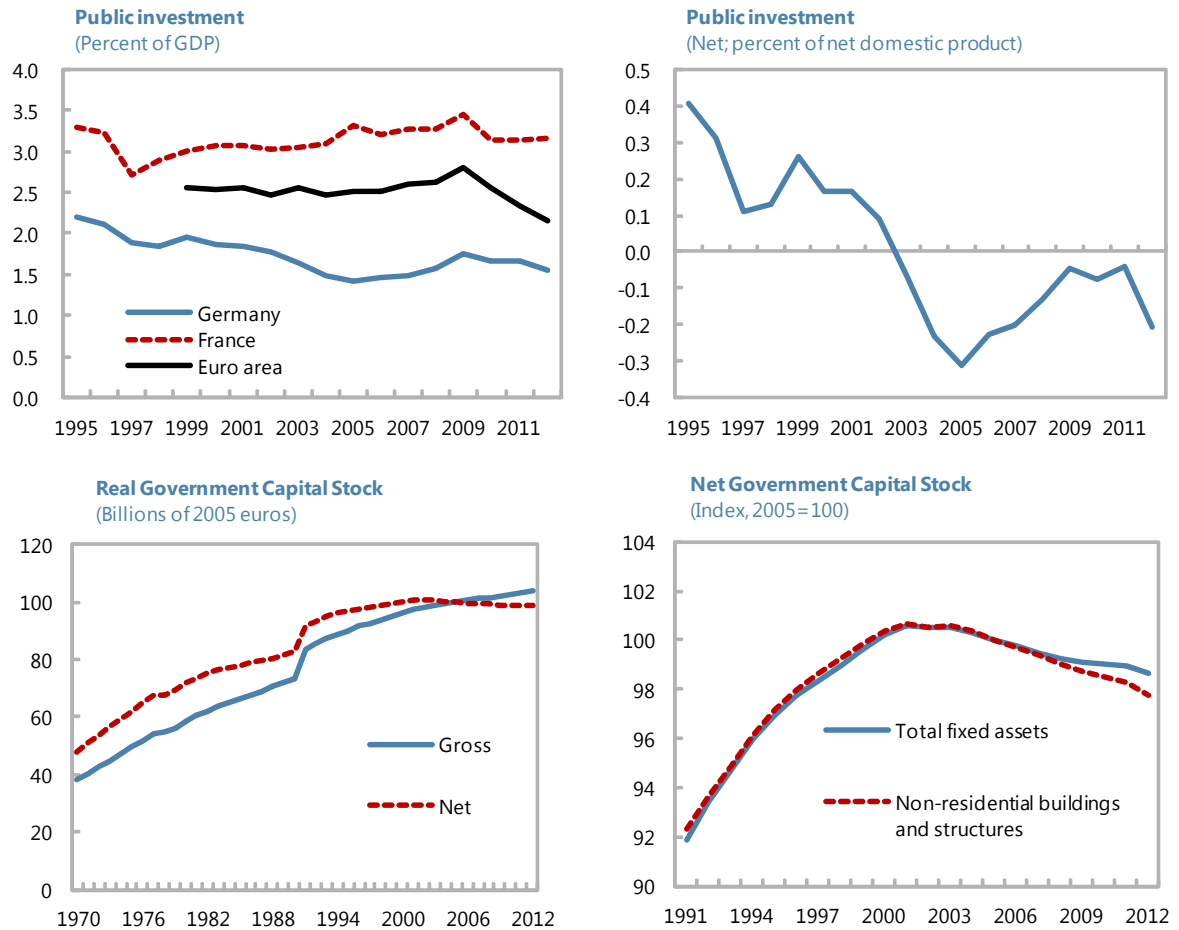
Working-Age Population Projections

(Index, 2014=100; population ages 20-65)



Sources: United Nations and authors' calculations.

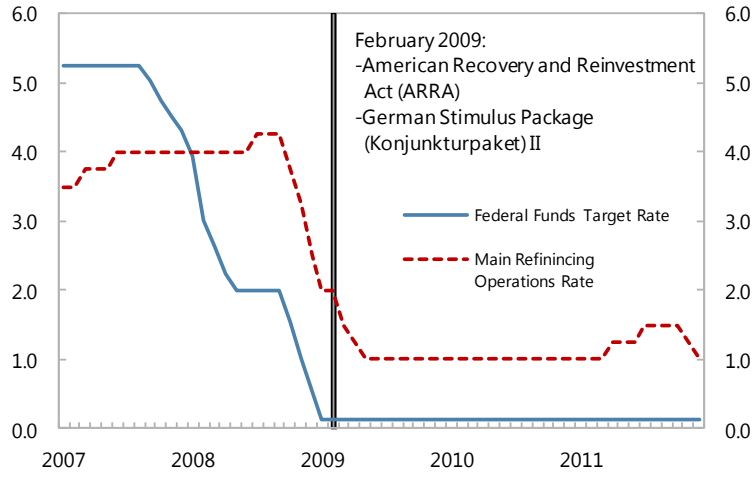
Figure 2. Germany: Public Investment and Capital



Sources: Haver Analytics and authors' calculations.

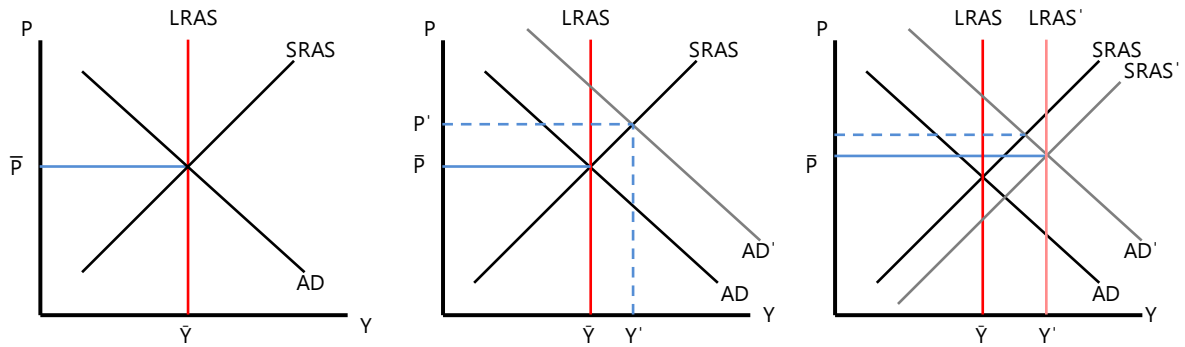
Notes: ESA 1995 data used for national accounts. However, using the recently released ESA 2010 national accounts statistics conveys broadly similar patterns as those conveyed by the ESA 1995 series used here: for example, the average net government investment-to-net domestic product ratio since 2004 is still negative. Country-specific differences (including which services are provided by the public and private sectors) should be recognized when comparing public investment across countries.

Figure 3. Fiscal and Monetary Stimulus: The United States and Germany
(Percent)



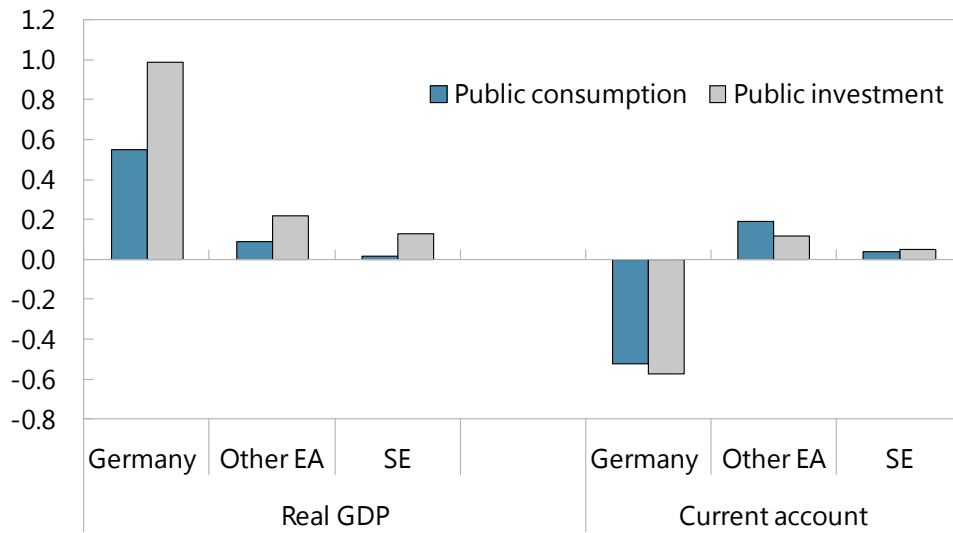
Source: Haver Analytics and authors' calculations.

Figure 4. Aggregate Supply and Demand



Source: Authors' calculations.

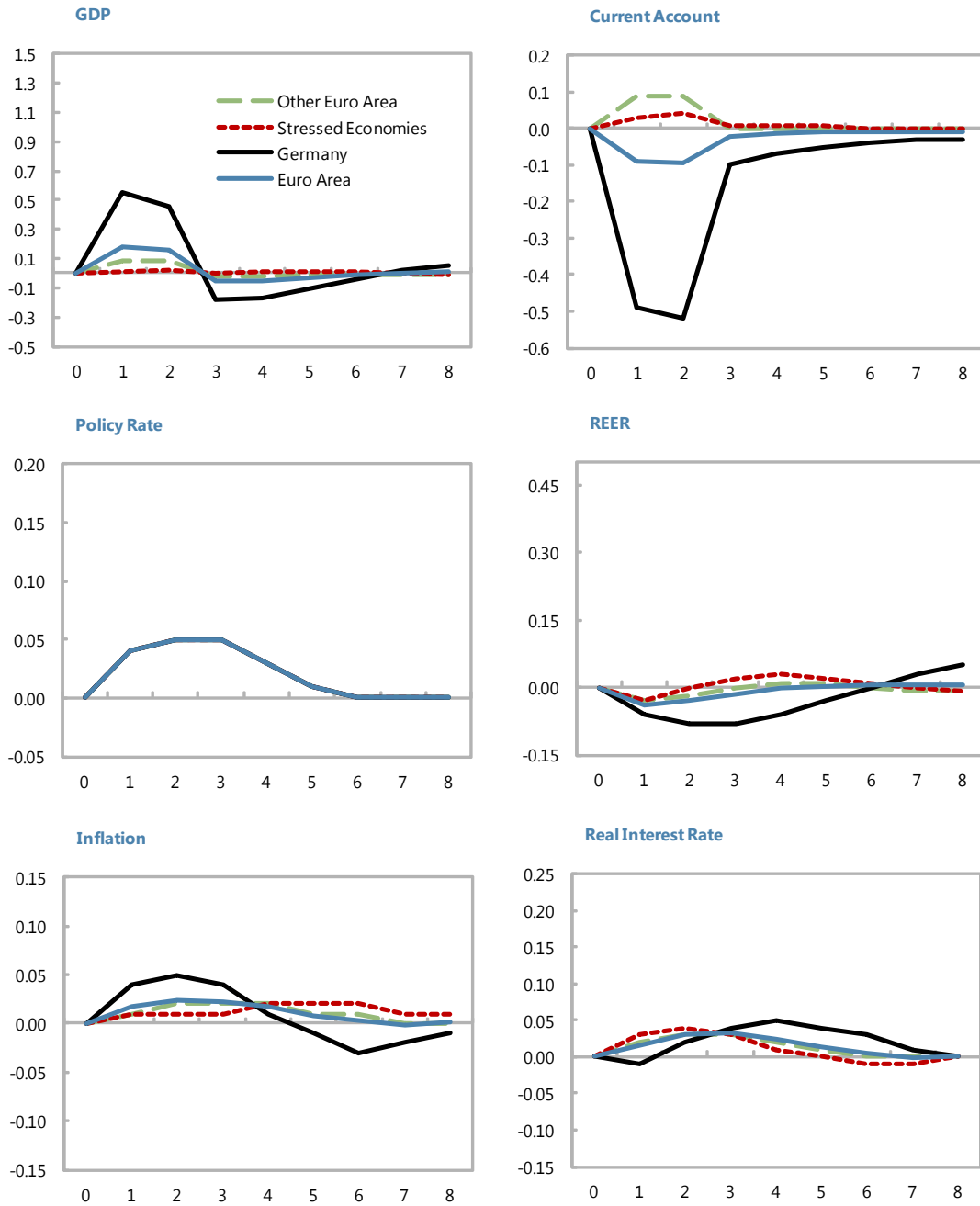
Figure 5. Germany: Higher Public Spending
(Deviation from baseline)



Sources: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 2 percent of GDP (1 percent of GDP per year) debt-financed increase in public consumption or investment. Real GDP and the current account (-to-GDP ratio) are measured in percent and percentage points, respectively.

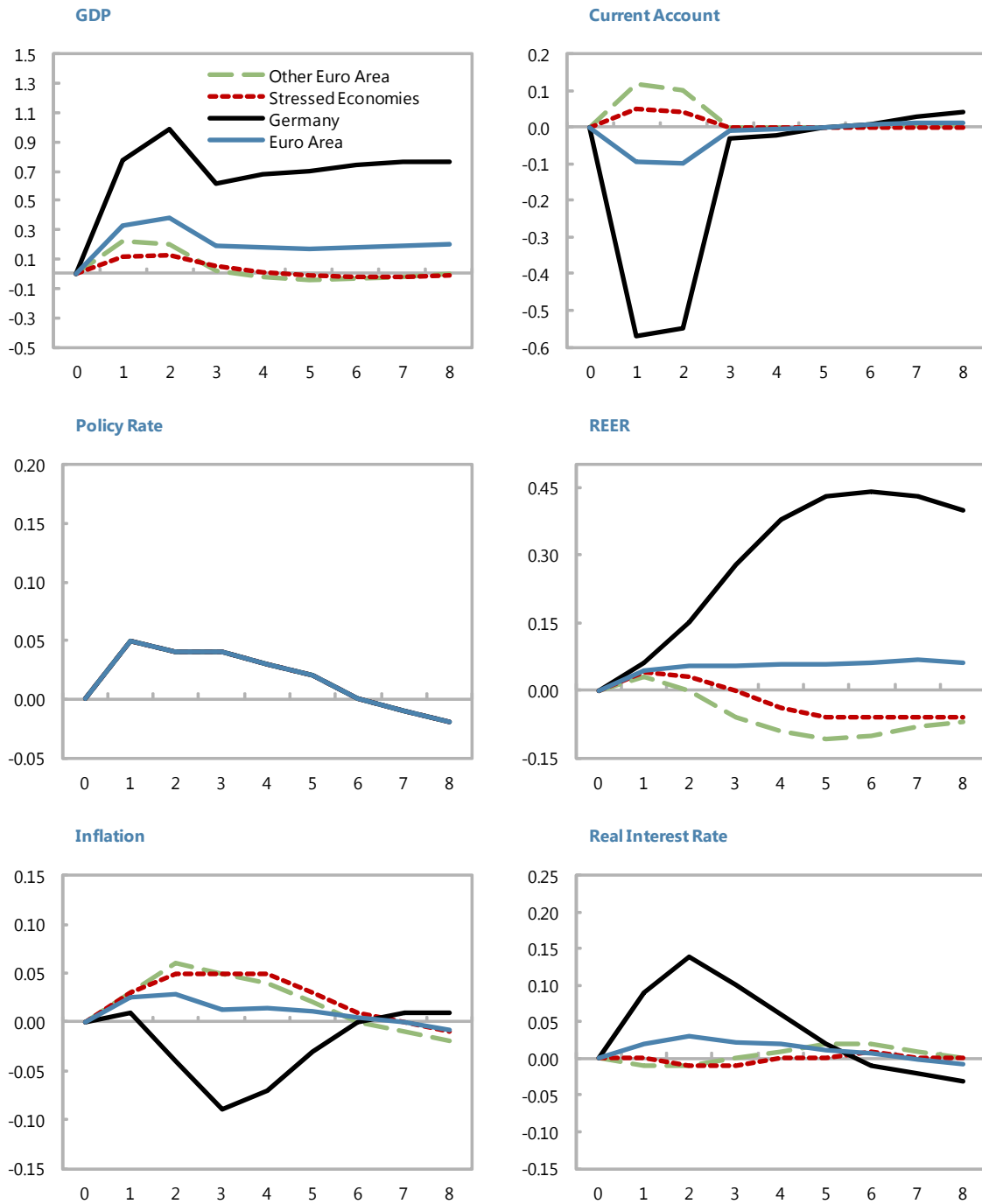
Figure 6. Germany: Higher Public Consumption (GOV_CON)



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public consumption. Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

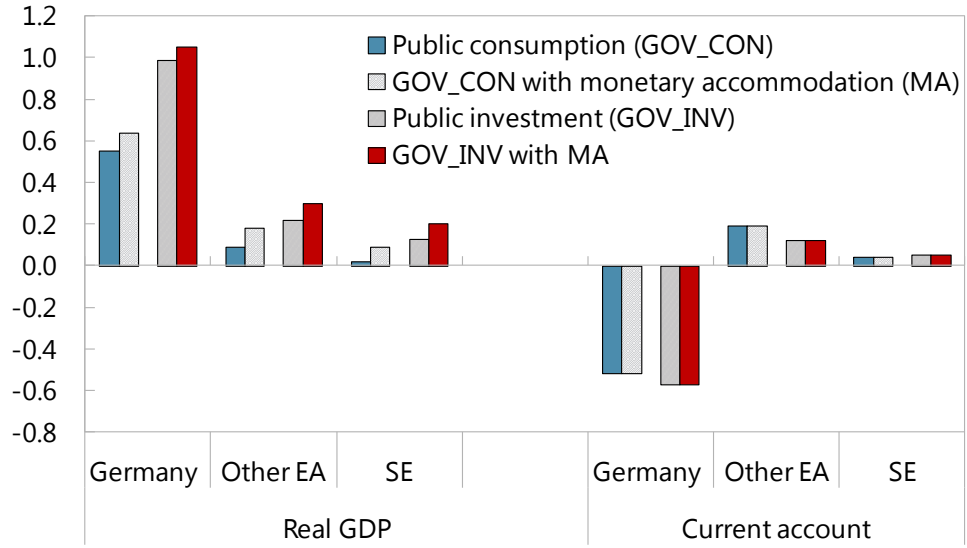
Figure 7. Germany: Higher Public Investment (GOV_INV)



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment. Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

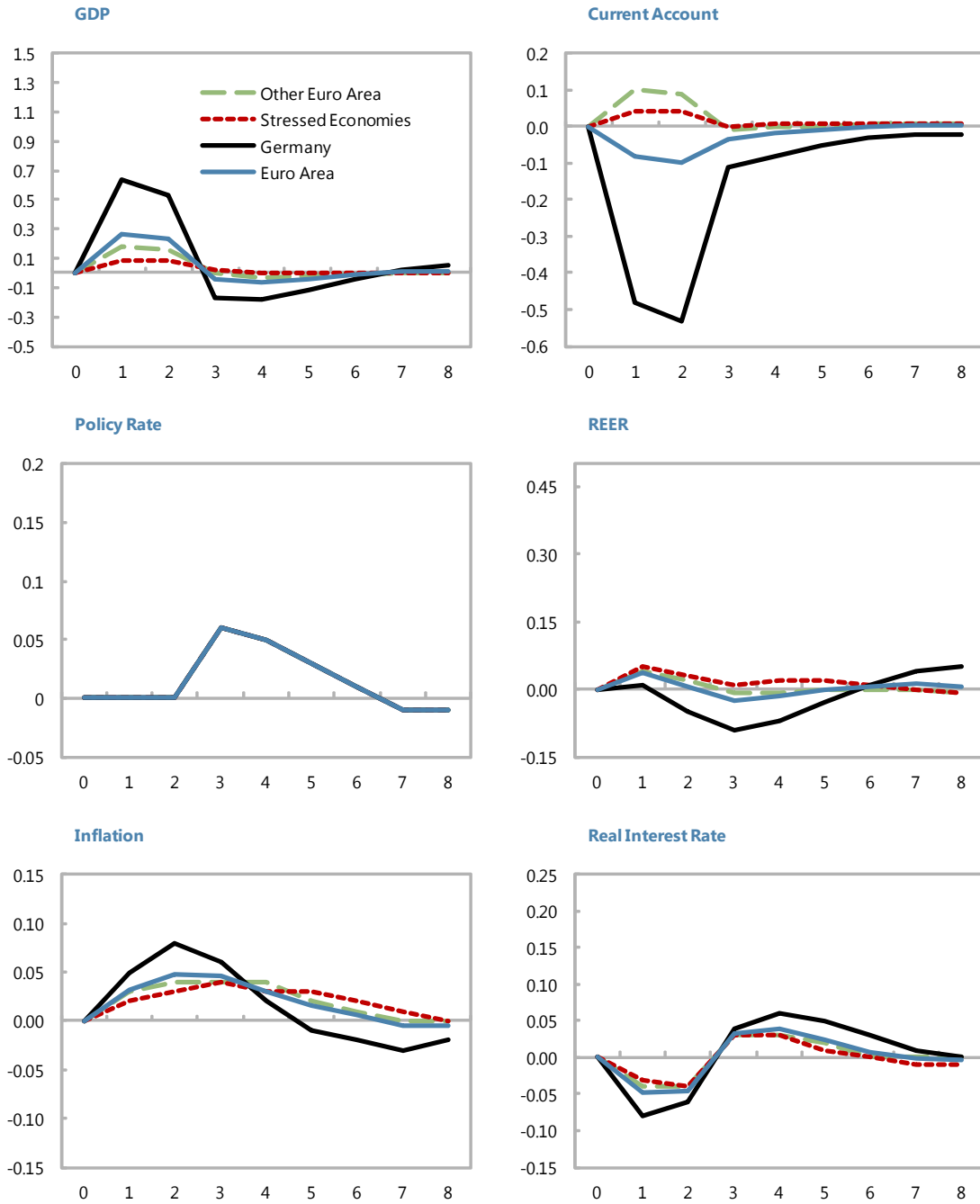
Figure 8. Germany: Fiscal Stimulus and Monetary Accommodation
(Deviation from baseline)



Sources: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 2 percent of GDP debt-financed increase in public consumption or investment, with and without monetary accommodation. Real GDP and the current account (-to-GDP ratio) are measured in percent and percentage points, respectively.

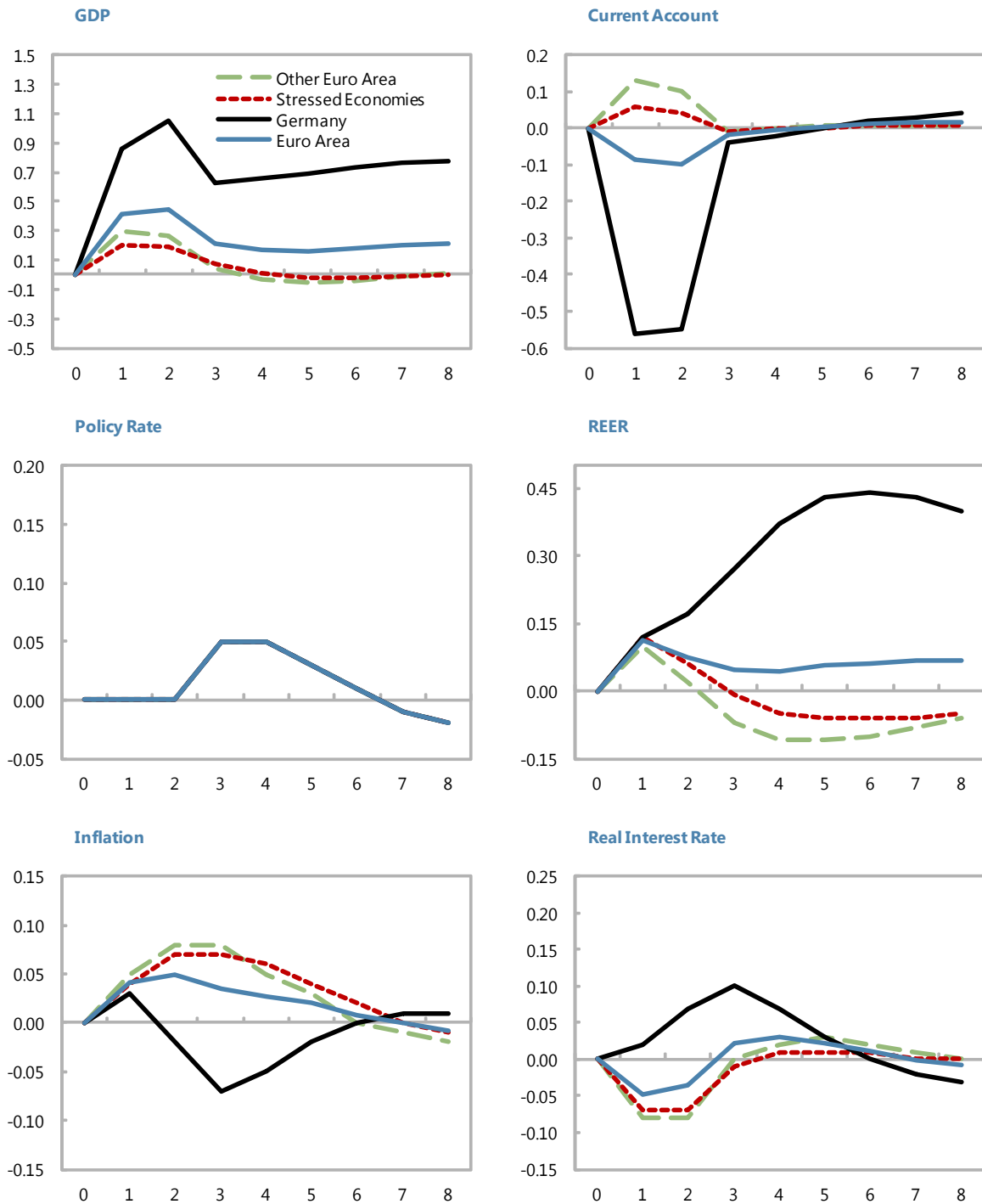
Figure 9. Germany: GOV_CON with Monetary Accommodation (MA)



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public consumption with 2 years of monetary accommodation (MA). Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

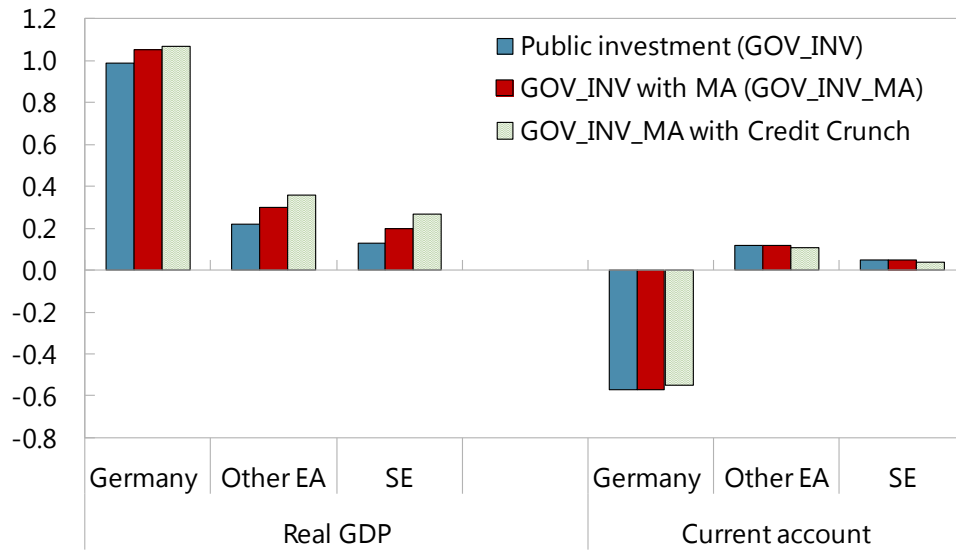
Figure 10. Germany: GOV_INV with MA



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment with MA. Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

Figure 11. Germany: Public Investment and a Credit Crunch
(Deviation from baseline)

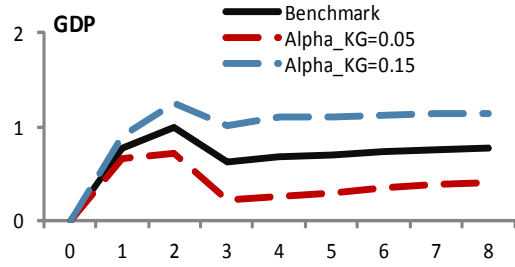


Sources: Authors' calculations.

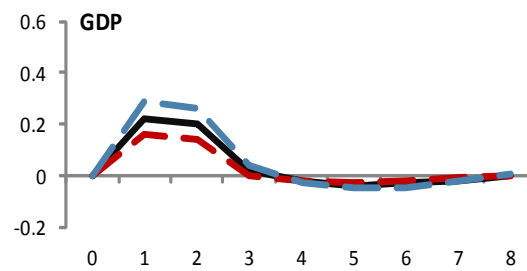
Note: Fiscal stimulus is a 2-year, 2 percent of GDP debt-financed increase in public investment, with and without monetary accommodation, and with a credit crunch. Real GDP and the current account (-to-GDP ratio) are measured in percent and percentage points, respectively.

Figure 12. Robustness: Output Elasticity of Public Capital
(Percent deviation from baseline)

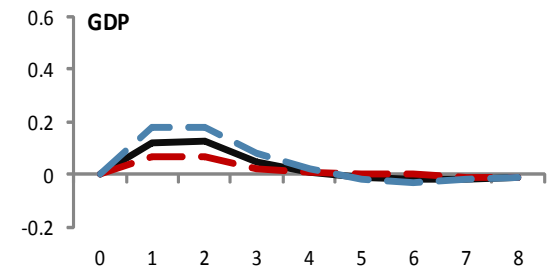
Germany



Othe Euro Area (OEA)

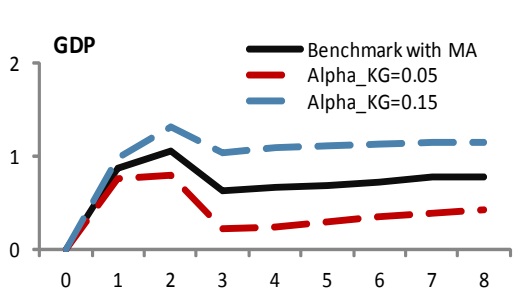


Stressed Euro Area (SE)

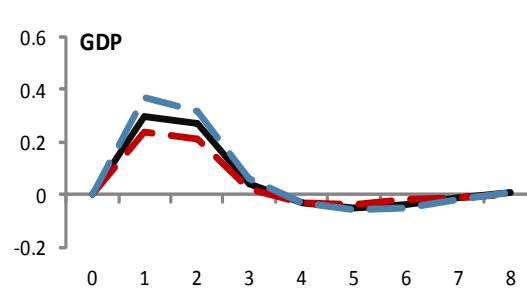


With monetary accommodation (MA)

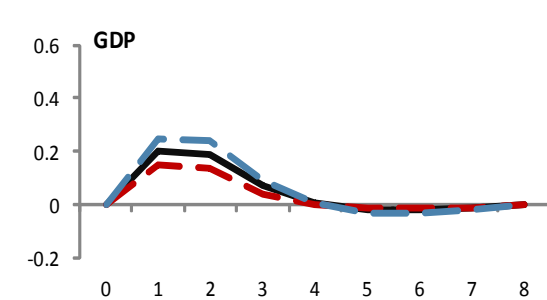
DEU



OEA



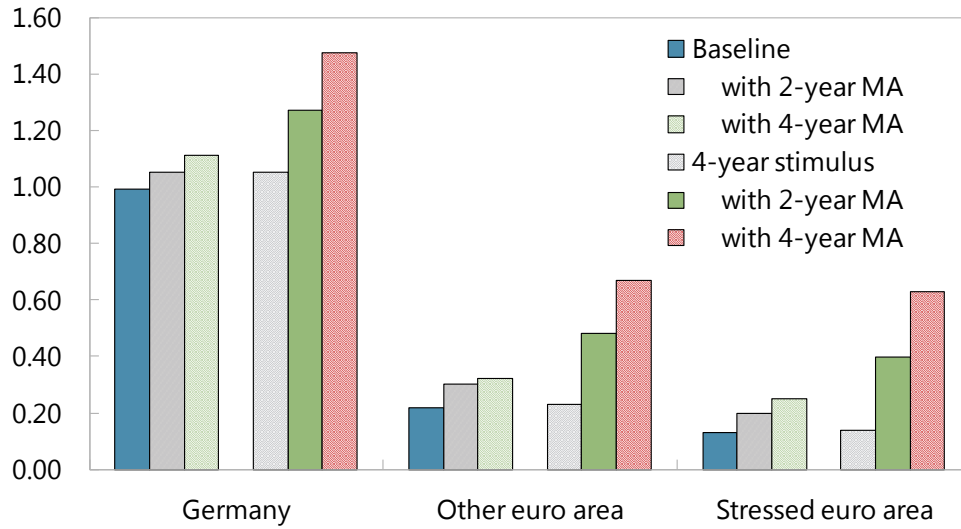
SE



Source: Authors' calculations

Note: Fiscal stimulus is a 2-year, 2 percent of GDP debt-financed increase in public investment, with and without monetary accommodation (MA).

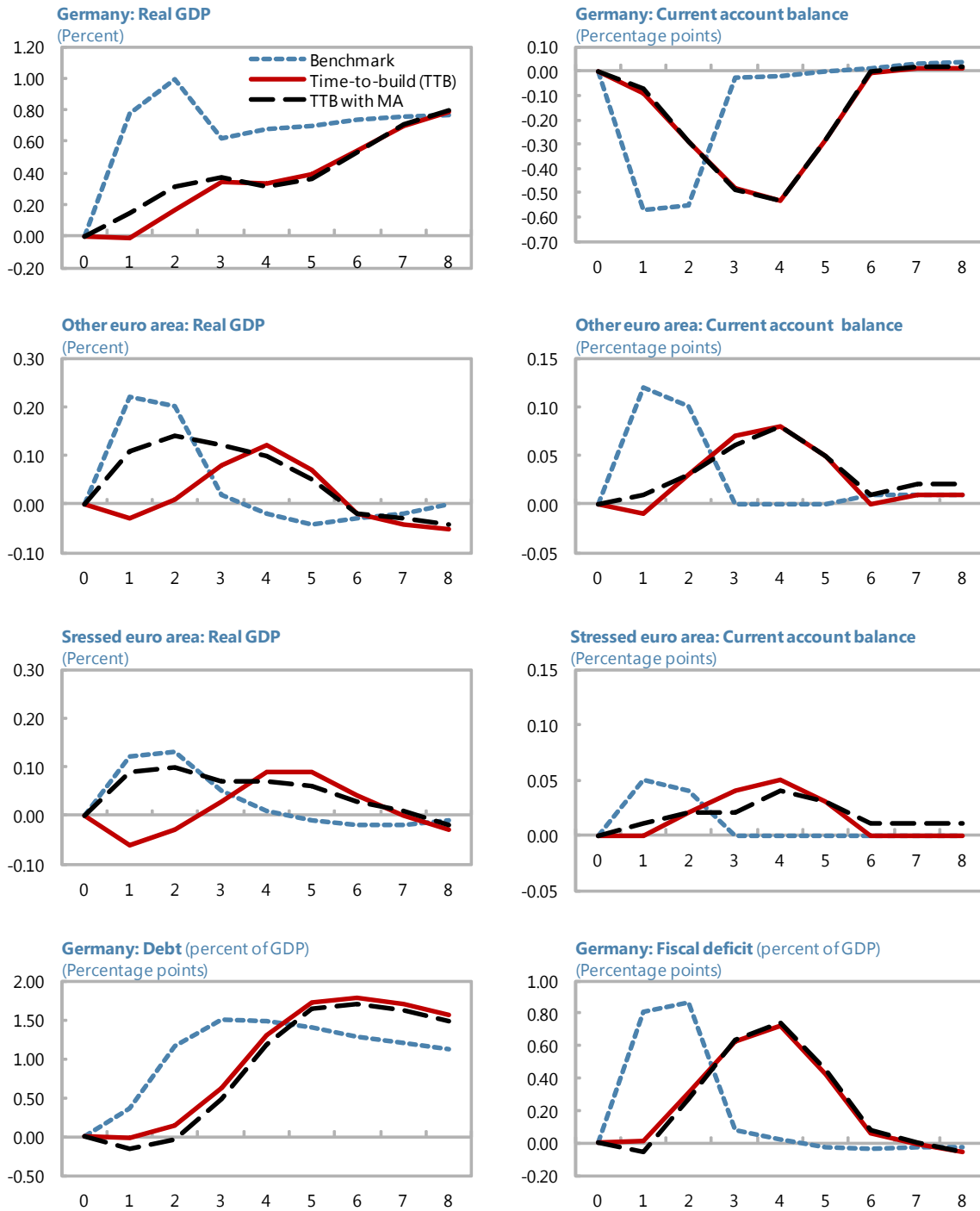
Figure 13. Germany: More Persistent Stimulus
(Real GDP, percent deviation from baseline)



Sources: Authors' calculations.

Note: Fiscal stimulus is a 2- or 4-year debt-financed increase in public investment with and without monetary accommodation (for 2 or 4 years).

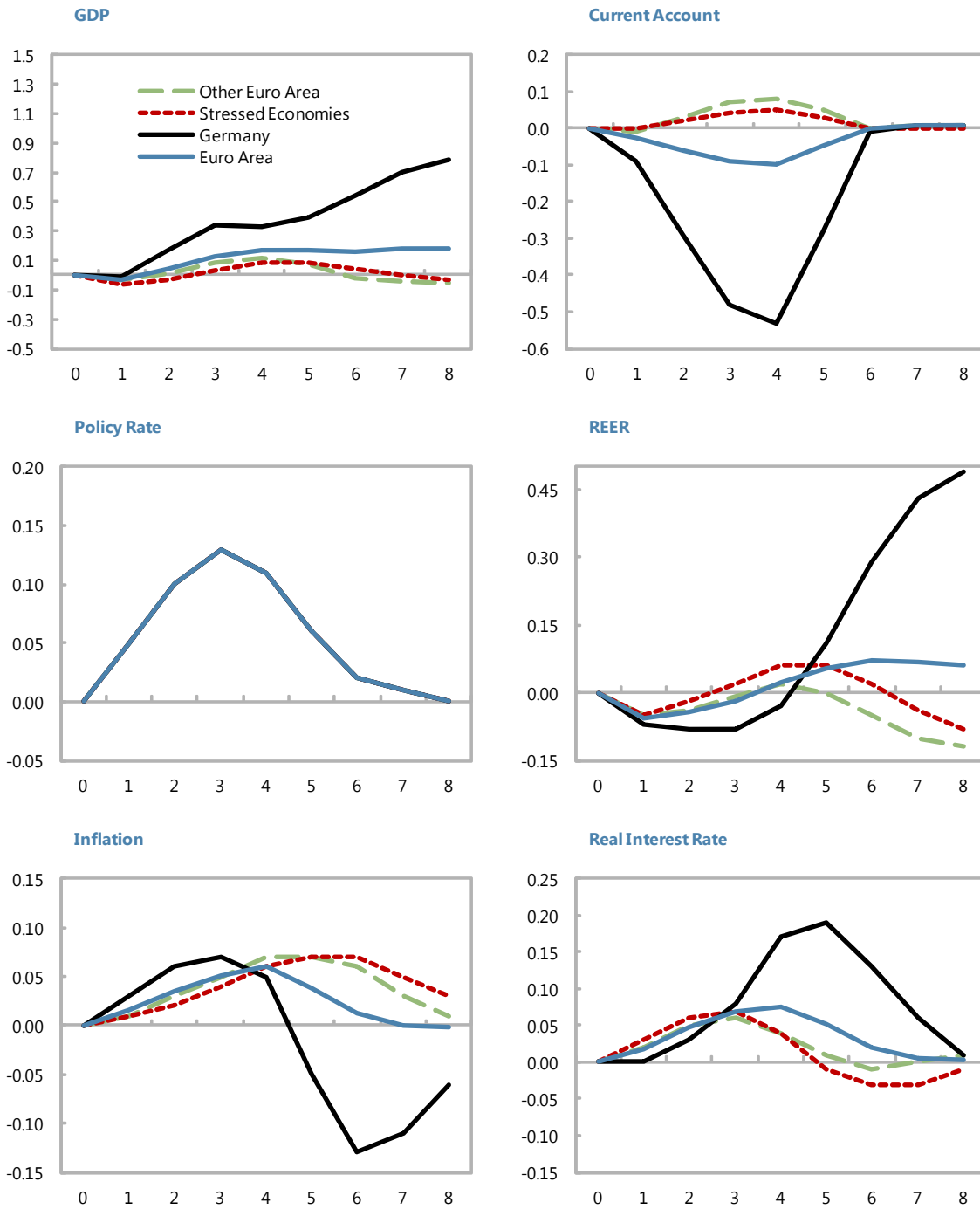
Figure 14. Higher German Public Investment: The Role of Time-to-Build Delays



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment, with and without 2 years of monetary accommodation (MA), with and without 3-year implementation delays (time-to-build—TTB) feature. Real GDP and the current account (-to-GDP ratio) as well as the fiscal variables are measured in percent and percentage points, respectively.

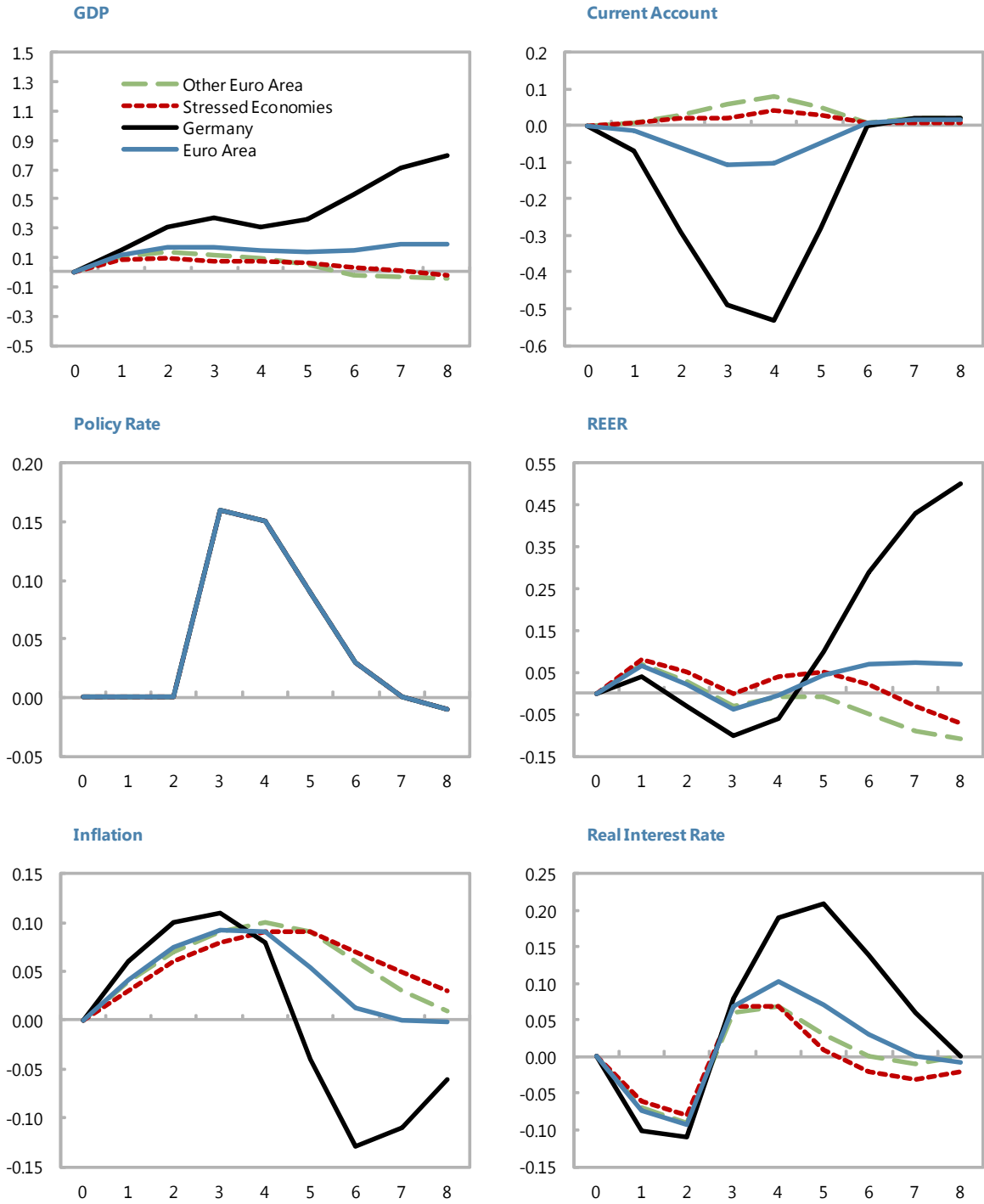
Figure 15. Germany: GOV_INV with Time-to-Build Delays (TTB)



Source: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment with 3-year implementation and time-to-build delays (TTB). Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

Figure 16. Germany: GOV_INV with TTB and with MA

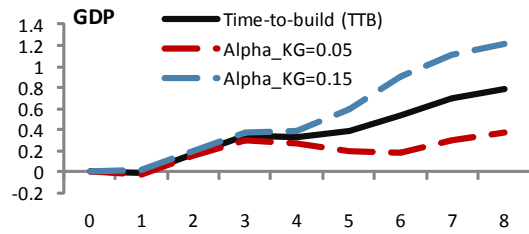


Source: Authors' calculations.

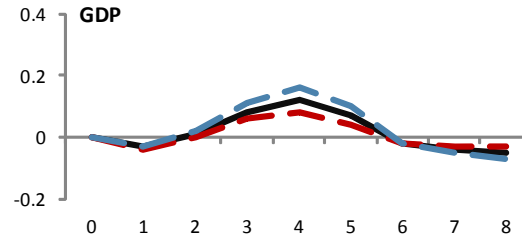
Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment with TTB and MA. Variables are percent deviations from baseline (current account-to-GDP ratio in percentage points). EA denotes the weighted average of DEU, OEA, and SE. REER denotes the real effective exchange rate (an increase represents a depreciation).

Figure 17. Robustness: Time-to-Build Delays
(Percent deviation from baseline)

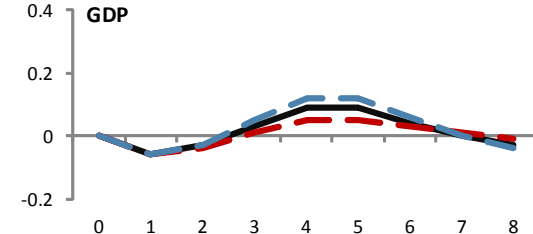
Germany



Othe Euro Area (OEA)

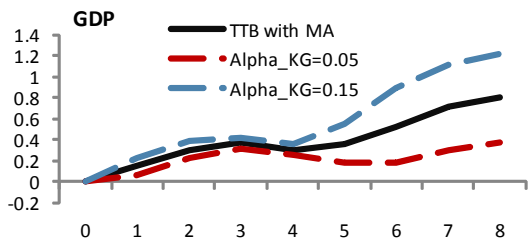


Stressed Euro Area (SE)

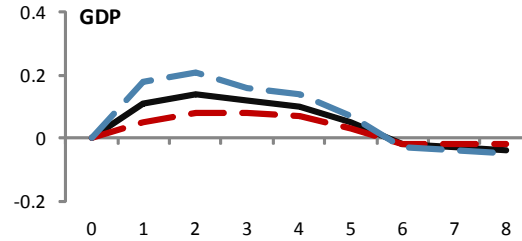


With monetary accommodation (MA)

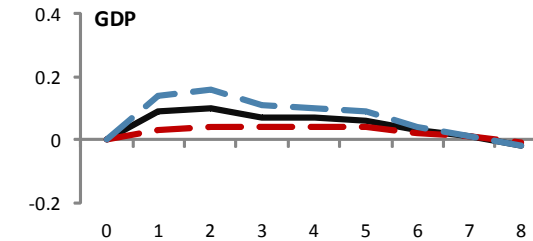
DEU



OEA



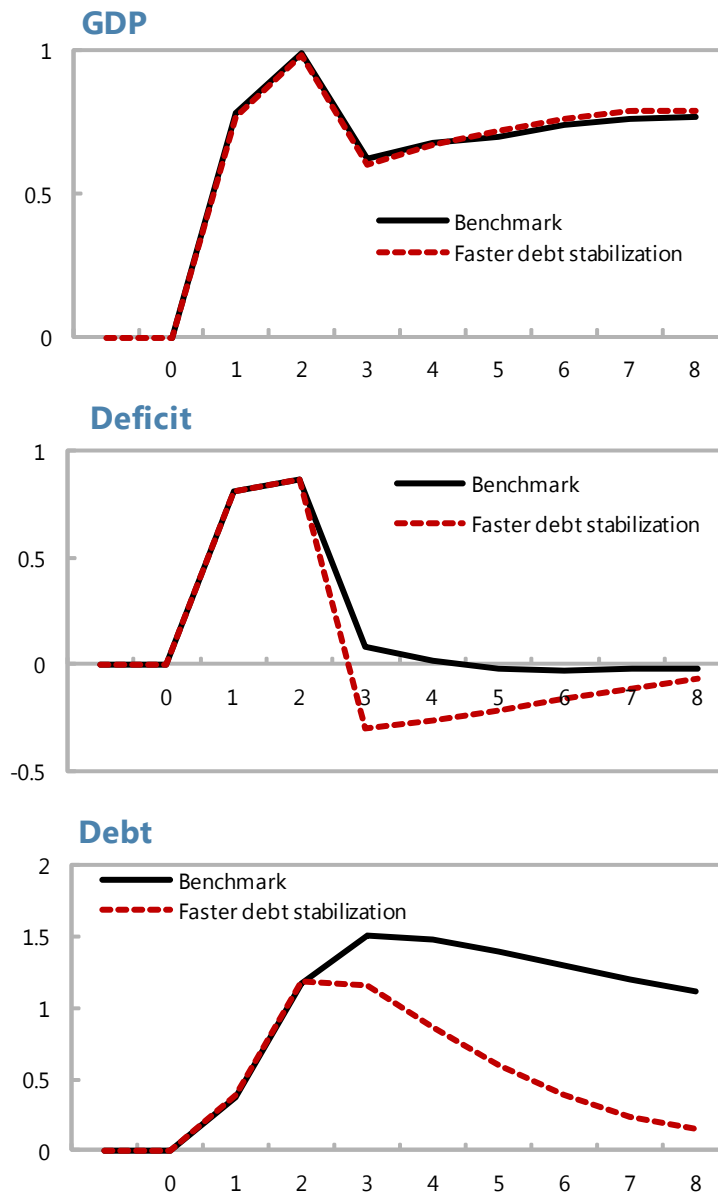
SE



Source: Authors' calculations

Note: Fiscal stimulus is a 2-year, 1 percent of GDP per year debt-financed increase in public investment, with and without monetary accommodation (MA), with and without 3-year implementation delays (time-to-build delays—TTB) feature.

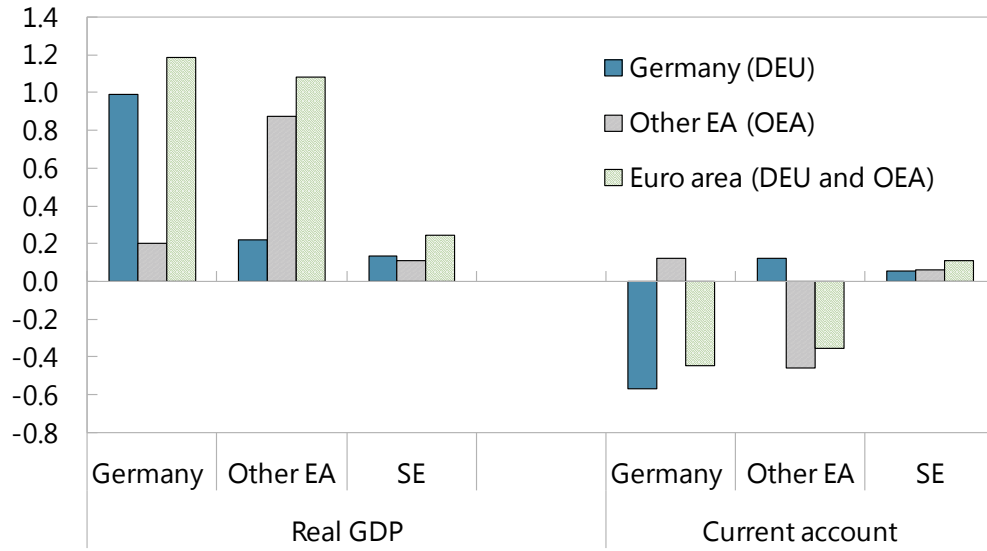
Figure 18. Germany: Faster Debt Stabilization



Source: Authors' calculations.

Note: The benchmark simulation is a 2-year, 2 percent of GDP debt-financed increase in public investment, whereas in the alternative simulation, debt is reduced 30 percent faster by cutting (non-distortionary) transfers. Real GDP and fiscal variables are measured in percent and percentage point deviations from baseline, respectively.

Figure 19. Coordinated Public Investment Spending
(Deviation from baseline)



Sources: Authors' calculations.

Note: Fiscal stimulus is a 2-year, 1 percent of GDP debt-financed increase in public investment implement in various regions. Real GDP and the current account (-to-GDP ratio) are measured in percent and percentage points, respectively.