CHAPTER 6

Public Investment over the Fiscal Cycle

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INTRODUCTION

Many countries responded to the global financial crisis by increasing public spending to soften the ensuing economic downturn (IMF 2010; Dhar 2014). Ten years later, public debt has surged to unprecedented levels, prompting calls for fiscal consolidation to rebuild fiscal buffers and curb public debt accumulation. Low-income developing countries in particular must tackle daunting challenges with rising debt vulnerabilities, in part resulting from protracted low commodity prices, leaving no option other than to consolidate.

Faced with limited options to raise revenue significantly in the short term, governments are often forced to rely on expenditure consolidation. However, changes in the composition of government spending during times of fiscal consolidation may affect growth outcomes and ultimately the success or sustainability of the consolidation. Evidence shows that capital spending is often cut during times of fiscal consolidation, despite the lasting benefits for growth attributed to public investment (see Chapter 2). As shown in Figure 6.1, a higher share of public investment in government spending tends to be associated with stronger growth.

The relationship between the size of government and economic growth has been extensively studied (for example, Barro 1990; Glomm and Ravikumar 1997; Ghosh and Roy 2004; Lee and Gordon 2005; Gómez 2007; and Arnold and others 2011). Only a few studies give much attention to the composition of public spending besides its overall size—and they have mixed results. For example, Gemmell, Kneller, and Sanz (2016) and Fournier and Johansson (2016) found that reallocating public spending toward infrastructure and education is conducive to higher long-term output levels in countries of the Organisation for Economic Co-operation and Development (OECD). Gupta and others (2005)

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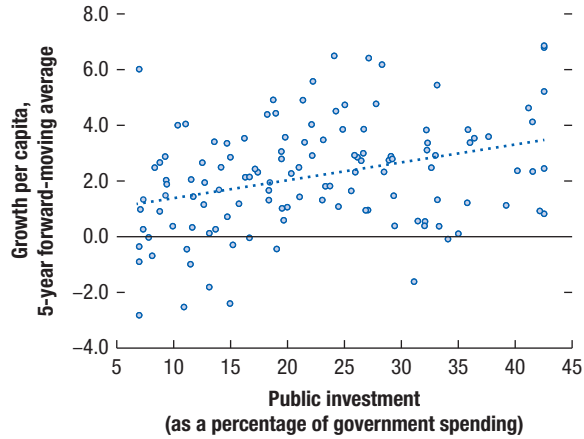
Figure 6.1. Per Capita Growth and the Share of Public Investment in Total Government Spending in Developing Economies, 2015–17



Source: IMF Capital Stock Data Set; and International Financial Statistics.
Note: The y-axis is a 5-year forward-moving average of per capita GDP growth for emerging market and developing economies (see Annex 6.2). Both public investment and 5-year forward-moving averages are averaged over 2015–17.

and Adam and Bevan (2003) have shown that fiscal consolidations achieved through cutting selected current expenditures and raising revenue (respectively) tend to raise medium-term growth rates, and protecting capital expenditures does the same. By contrast, earlier studies such as Devarajan, Swaroop, and Zhou (1996), and Ghosh and Gregoriou (2008) found a positive relationship between the current component of public expenditure and per capita real GDP growth for a group of low-income developing countries spanning the 1970s and 1990s.

This chapter investigates the growth dividends of shifting government spending composition toward more public investment during the fiscal cycle. Fiscal cycles are defined as fluctuations in the primary balance in response to government action or macroeconomic shocks. Using complementary general equilibrium and data-driven models, the findings suggest that protecting investment spending during times of consolidation—although contractionary in the short term—boosts medium- to long-term growth, leading to a more sustained reduction in the budget deficit. However, the growth benefits from rising shares of public investment in total government spending decline beyond a threshold. This result, which also holds during good times, underscores the importance of public investment for growth, particularly in countries with low initial public investment in government expenditure.

The chapter outlines the theoretical model and discusses simulation results of increasing public investment during the fiscal cycle, then presents complementary empirical evidence and some policy implications.

THEORETICAL MODELING AND SIMULATIONS

Trade-offs between public current expenditure and public investment occur over the fiscal cycle. The associated effects on output can be estimated using simulations of a dynamic stochastic general equilibrium model with the following specifications:

- Households. Consumers spend and save given their budget constraints. The taxes they pay on consumption, as well as labor and capital incomes, finance public expenditure.
- Government. The government uses the collected tax revenue to finance current expenditures (such as wages and salaries) and capital expenditure (such as infrastructure projects).[1]
- Firms. They employ labor and rent capital from households; their production also depends on the government's current expenditures and the stock of public capital. Both types of government spending have a productive impact on output: (1) current expenditures contemporaneously affect output because of spillovers from productive current expenditures (such as health expenditures that raise labor productivity), while (2) capital expenditure creates productivity-enhancing public capital (such as physical and information and communication technology infrastructure).[2]
- Policy simulations. The model is calibrated to mimic a typical developing economy, whose characteristics draw on previous studies and on data used in the empirical section of this chapter (see Annex 6.1). For simplicity, shocks that trigger the need for fiscal consolidation are not analyzed and it is assumed that expenditure restraint is required to achieve this consolidation.

Differences associated with changing the public spending mix—between public current and capital expenditures— are analyzed and quantified and the implications for short-term and long-term growth considered. On one hand, as current expenditures have more immediate effects on economic activity than public investment, spending that is more tilted toward current expenditures amid transient negative shocks would better support short-term growth. On the other hand, public spending tilted toward public investment helps achieve better long-term objectives, although with a more limited short-term impact on growth.

The model simulations in this chapter provide a way to assess which strategy delivers the best outcome. Assuming that a fiscal consolidation equivalent to a

[1] Debt financing of the budget deficit is assumed away for simplicity, as the scope of this chapter lies only in the benefits of varying the spending mix over the fiscal cycle.

[2] The assumption that public expenditure—in infrastructure, research, education, and health services—is productive is widely recognized in the empirical literature (for a survey, see Romp and de Hann 2007). In line with previous studies, public investment is introduced in the form of a change to the public capital stock in the production of the firm (for example, Leeper, Walker, and Yang 2010), whereas current expenditures enter as a flow variable (for example, Aschauer 1989; and Barro 1990).

decrease of 1 percentage point in total government spending to GDP is required, the impact of cutting current and capital spending in response to an increasingly constrained budget is examined over both short and long terms.[3] Two extreme cases are considered. In the first scenario, the burden to deliver needed consolidation falls entirely on current expenditure, meaning that capital spending is fully preserved. In the second scenario, public investment fully adjusts, whereas current expenditure remains unchanged. Focusing on these two extreme cases provides useful insights about the possible macroeconomic outcomes of any intermediate expenditure mix.

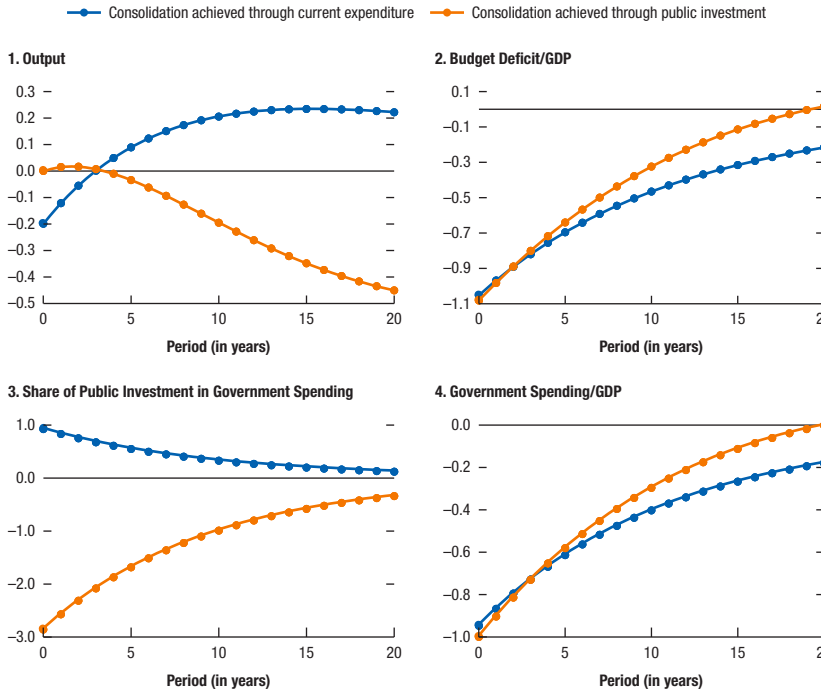
The results are illustrated in Figure 6.2. This shows the macroeconomic impact of a 1 percentage point temporary cut in government spending to GDP relative to the steady state. The simulations show notable trade-offs associated with the government spending mix after the shock. A cut in public investment, though maintaining government consumption, produces an almost negligible impact on short-term output as the drop is compensated by a contemporaneous increase in consumption and private investment, hence raising the stock of private capital. However, this comes at the cost of a steadily declining output starting from the fourth year, reaching –0.45 percent of GDP by the end of the time horizon considered (20 years). In contrast, a consolidation that relies entirely on current expenditure, while protecting capital spending, would be contractionary in the short term with a notably contemporaneous drop in output of 0.2 percent of GDP, but output recovers by year three and expands in the long term to stabilize just above 0.2 percent of GDP after 10 years, enough to offset the initial negative impact. Although the short-term growth differential between the two scenarios would argue in favor of cutting public investment, this gap closes within three years and is reversed in the long term to reach around –0.4 percent of steady-state output in 10 years and more than 0.6 percent of GDP by the end of the time horizon.

Given that preserving public spending achieves higher long-term growth, it ensures the durability of fiscal consolidation with sharper medium- and long-term reductions in fiscal deficits (as illustrated in Figure 6.2). This policy approach is naturally favorable when pursuing long-term objectives—such as debt sustainability—which would require a sustainable containment of fiscal deficits. However, it comes at the short-term cost of output contraction. On the other hand, the model illustrates the negligible short-term output benefits from consolidations achieved through cuts to public investment. Although providing limited temporary relief, this approach exacts a steep cost in the form of sustained contractionary pressures on future output and a reversion to initial deficit levels.[4] These results caution against pursuing short-sighted policies to achieve short-term objectives that could be driven by economic or political considerations.

[3] It is assumed that the cut in public expenditure is phased out gradually over time, such that its log-linear evolution follows an AR (1) process with a persistence parameter that is set to 0.9 (see Annex 6.1).

[4] The conclusions are broadly similar when running the simulations for a permanent shock to government expenditure.

Figure 6.2. Impact of a Reduction of 1 Percent in Government Spending on Output and Fiscal Outcomes



Source: IMF staff.
Note. The y-axis captures the percentage point deviation of the respective variable from its steady-state level.

Some caveats to the analysis are worth noting. Although the parameters of the model are carefully chosen to feature the characteristics of a typical developing country, wide heterogeneity in this income group cannot be ignored; the magnitude of the responses to cuts in current and capital expenditure—as measured by the respective output elasticity—will vary with country-specific circumstances.[5] Another important consideration is the inefficiency of public investment, which is typically sizable in low-income countries (see Chapter 3 for an in-depth discussion). Such inefficiencies—that could result from public investment mismanagement—imply that only a fraction of investment is transferred into public capital (see Dabla-Norris and others 2012; and IMF 2015). Because higher inefficiency means a lower expected fiscal multiplier to public investment, the long-term positive effects on output shown in Figure 6.2 may not materialize.

[5] Therefore, for country-specific studies, the output elasticity of capital and current expenditures must be estimated as accurately as possible (for a survey of the empirical literature, see Romp and de Haan 2007).

CROSS-COUNTRY EMPIRICAL EVIDENCE

Empirical evidence on the link between the public spending mix and per capita growth during fiscal consolidations complements the analysis, A sample of 155 developing economies spanning 1960–2017 is used. This data-driven approach allows evaluation of the performance of medium-term growth when the public spending mix changes. It presents important advantages over simulation-based methods, notably the ability to (1) exploit a wide data set and extract common trends, (2) control for a larger set of factors that also affect growth, and (3) test nonlinearities in the relationship between growth and spending composition.

The analysis uses a regression that links growth to macroeconomic controls. The model incorporates two main variables: the share of public investment in total government spending and an indicator of fiscal consolidation episodes. The underlying idea is to see if differences in the composition of spending matter when the restoration of fiscal control is needed. The impact on growth of changes to the spending mix is likely to depend on the availability of fiscal space, the health of macro fundamentals, and, broadly, the domestic policy stance over the fiscal cycle. The model accounts for this by including two broad groups of control variables denoted, respectively, as "fiscal space" and "macro-stability" (for details, see Box 6.1).

Results and Discussion

Changing the spending mix in favor of public investment has strong growth dividends. A simplified version of the empirical model is first estimated without interactions of public investment with fiscal consolidation indicator variables (see Annex Table 6.3.1). After controlling for fiscal space, macroeconomic stability, and fixed effects, the results strongly support the hypothesis that the public spending mix matters for medium-term growth—a finding consistent with earlier findings. Increasing the share of public investment in total government spending from 10 to 20 percent raises medium-term growth by 0.5 percentage point. Interestingly, the results also suggest stronger growth dividends when the share of public investment in spending is low: as the share of public investment grows and reaches around 30 percent of total government spending, its growth dividends marginally decline (Figure 6.3).[6]

This nonlinear relationship persists as more controls are added.[7] This suggests that the public spending mix matters for medium-term growth, more so when public investment accounts for a smaller share of public spending. The intuitive explanation could be that though a higher share of government spending devoted to capital expenditure is good for growth, the return diminishes beyond a threshold, as current expenditure is also needed to maintain a minimum provision of public services.

[6] This nonlinearity is captured by including a square term of the share of public investment in spending. The coefficient on this variable is negative and significant.

[7] The inverse min-U test (Lind and Mehlum 2010) fails to reject the existence of a monotone relationship, in all but column 4 in Annex Table 6.3.1, in relation to an inverse U-shaped relationship.

Box 6.1. Linking Composition of Public Spending to Economic Growth

The regression is specified as follows.

Dependent Variable

Rich empirical evidence shows that public investment and economic activity do not always move in tandem. For example, Jones (1995) found that every time investment rates increase, countries of the Organisation for Economic Co-operation and Development experience transitory growth effects lasting five to eight years. Therefore, a forward-moving average of per capita real GDP growth is chosen as the dependent variable to capture both the contemporaneous and medium-term growth effects associated with fiscal adjustments (such as changes in the spending mix during consolidation).[1]

Explanatory Variables

- *Spending mix*. The spending mix is captured by the inclusion of the ratio of capital spending as a share of total government expenditure. To ensure the model specifically captures the impact of changing the public spending mix, the size of total public spending as a ratio to GDP is controlled for.
- *Fiscal space and macroeconomic stability*. The regression covers all four fundamental components of fiscal space: debt sustainability, balance sheet composition, external private sector debt, and market access (IMF 2018). The empirical model captures at least three of these dimensions by using two variables, the *current account balance* and *central bank assets as shares of GDP*. The first measures the extent to which governments can flexibly meet domestic consumption and investment requirements. The second measures the macroeconomic and financial stability provided by central balance sheets. Where payments technology is heavily reliant on currency (rather than on e-transfers), central bank assets are an important buffer to meet payment obligations. This is especially true in low-income developing countries. In contrast, because the asset-side buildup of central bank balance sheets needs to be balanced by an increase in domestic liabilities, there is a chance that some of the benefits gained from asset buildup are offset by some loss in domestic financial intermediation. The degree to which economies minimize vulnerability to external shocks has desirable implications for sustained growth. A wide body of historical evidence ascribes long bouts of low growth and volatility in developing countries to the absence of macroeconomic stability. For the purposes of the study, the stability of macroeconomic outcomes is gauged by a set of controls, including *inflation*, *change in the real exchange rate*, and *government debt* (in percentage of GDP).

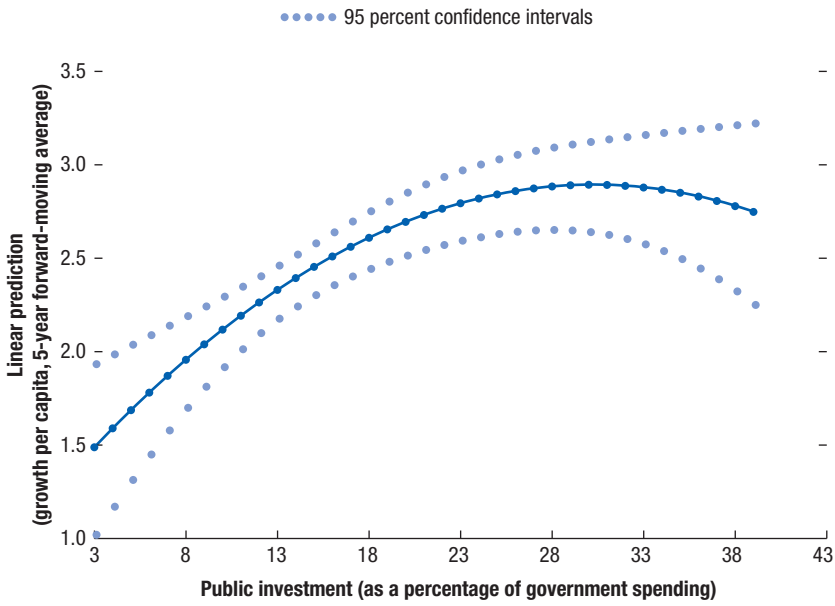
Other Controls

Country and time fixed effects are also included.

Source: IMF staff.
Note: See Annex 6.1 for more details.

[1] This approach is also consistent with Devarajan, Swaroop, and Zou (1996); Ghosh and Gregoriou (2008); and Afonso and Alegre (2011).

Figure 6.3. The Nonlinear Relation between Spending Composition and Growth



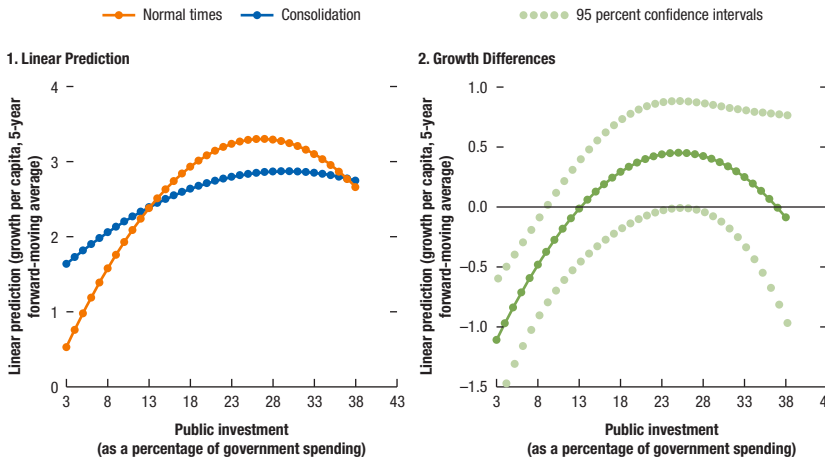
Source: IMF staff.
Note: The figure plots marginal effects from column 4 of Annex Table 6.3.1. It shows the relation between the public spending share of investment and its future growth effect (5-year forward-moving average of growth). All other variables in column 4 are computed at their average.

Moreover, an increase in capital expenditure often translates into an increase in current expenditure because of the knock-on effect of operations and maintenance spending. Underfunding of those outlays can lead to a rapid depreciation of the public capital stock, therefore undermining the expected benefits for growth.

The next step is to investigate whether this relationship holds during good times—when consolidation is not observed—and bad times (when fiscal consolidations are observed). The definitions of fiscal consolidation used in this study largely follow the more recent literature (Von Hagan, Hughes Hallet, and Strauch 2002; Adam and Bevan 2003; Gupta and others 2005). Two narrow definitions of fiscal consolidation are tested. In the first instance, a fiscal consolidation period is defined as events in which primary balances are tightened by at least 1 percent of GDP in two successive years after the primary deficit grew beyond 3 percent of GDP. Countries with a large deficit might need a longer time to rectify the fiscal stance. This is not explicitly accounted for in this definition. Instead of considering longer sequential consolidation, the analysis sticks to the two consecutive year definition, in line with existing literature and for simplicity. The second definition considers any reduction in the primary deficit in two consecutive years after a deficit of 1.5 percent of GDP or higher.

Once again, the spending mix has a significant impact on medium-term growth and depends on the initial spending mix.[8] The inverted U-shaped relationship between the share of public investment in total expenditure and growth holds during the fiscal cycles, in both good and bad times. Panel 1 in Figure 6.4 plots predictions of medium-term growth (see Annex Table 6.3.2, column 4) to illustrate the implications of changing spending compositions in good times and in times of consolidation. The figure suggests that the growth dividend from increased public investment is higher when the initial share of public investment is low. At lower shares of public investment, predicted growth rises sharply. That is because spending shares favor public investment during consolidations. Yet, for a given share of public investment, predicted growth is lower in bad times than in good times. This gap shrinks rapidly and becomes statistically insignificant for higher shares of public spending (Figure 6.4, panel 2). For example, doubling the investment share of public spending to 20 percent from 10 percent increases future growth (5-year moving average) by 0.69 percentage point during good times relative to 1.65 percentage points during consolidations. As the share increases to 30 percent, the growth effects are reduced to 0.33 percent and 0.66 percent, respectively. Growth effects are indistinguishable as the share of investment reaches 35–40 percent.

Figure 6.4. Importance of Spending-Composition Changes during Consolidation



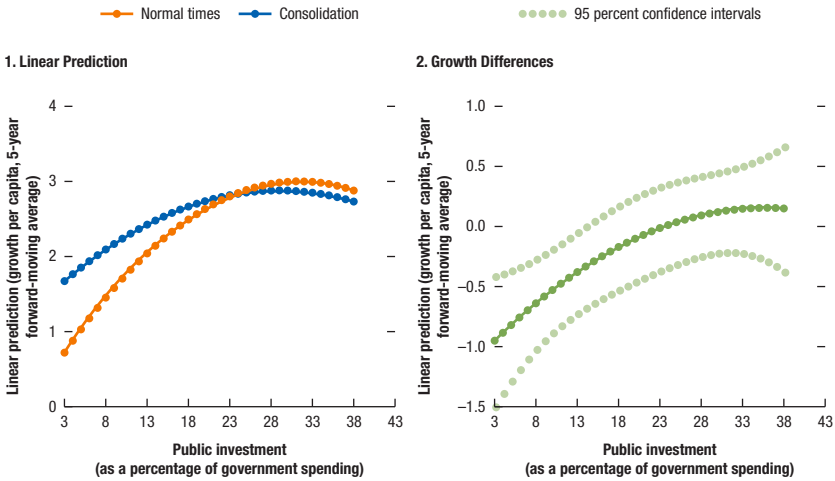
Source: IMF staff.
Note: "Fiscal consolidation" is defined as a reduction of 1 percent of GDP or more in the primary deficit in two consecutive years after the fiscal deficit climbed above 3 percent of GDP. Panel 1 plots predictions of medium-term growth (GDP per capita, 5-year forward-moving average) in the two states (see Annex Table 6.3.2, column 4). Panel 2 plots differences of the growth impacts in the two states. It shows that the spending share of public investment is as important during consolidations as in good times.

[8] Results with interactions between the public spending mix and fiscal consolidation (first definition) are shown in Annex Table 6.3.2.

As shown in Annex Table 6.3.2 (column 3), the impact of fiscal space and macroeconomic stability on growth is broadly in line with expectations. However, while all fiscal space indicators are expected to affect growth positively, central bank assets have a negative impact. A possible explanation could be that a buildup in the asset side of central bank balance sheets requires a similar increase in domestic liabilities, which signals diminished domestic financial intermediation. Controlling for additional growth determinants (human capital, financial development, and trade openness) does not alter the findings (see Annex Table 6.3.3).

Moreover, these results do not change when a broader definition of fiscal consolidation is applied (see Annex Table 6.3.4) or when the sample is expanded to include advanced economies.[9] Figure 6.5 compares the medium-term growth effects of spending compositions in the two states. Again, panel 1 shows that the growth dividend in both states from increased public investment is higher when the initial share of public investment is low, and then declines beyond a threshold. The right panel shows that these growth effects are statistically indistinguishable in the two states for higher shares of public investment.

Figure 6.5. Importance of Spending-Composition Changes during Consolidation (Using a Broader Definition of "Consolidation")



Source: IMF staff.
Note: "Fiscal consolidation" is defined as any deficit reduction when the primary deficit is above 1.5 percent of GDP. Panel 1 plots predictions of GDP per capita in the two states (from Annex Table 6.3.4, column 4). Panel 2 plots predicted growth impacts from the two states. It shows that increasing the investment share of public spending up to a threshold is associated with sharper increases in per capita growth during consolidation (relative to good times). These differences in growth impacts disappear at higher shares of public investment.

[9] Results are not presented here but are available upon request.

CONCLUSIONS

This chapter investigates the impact of government spending composition on growth during the fiscal cycle. A dynamic stochastic general equilibrium model, calibrated for a hypothetical developing country and empirical estimations, shows that

- A trade-off exists between short-term and long-term growth during consolidation times, as current public expenditures have a more immediate impact on output than public investment. As a result, a cut in public investment barely affects short-term output but proves to be costly in the medium to long term. On the other hand, a consolidation that relies entirely on current expenditure, while protecting capital spending, would be contractionary in the short term, but output recovers quickly and expands sustainably in the long term, fully offsetting the initial negative impact. This also leads to a more sustained reduction in the budget deficit.
- While tilting the composition of spending toward public investment is growth enhancing, the greatest benefits are felt for low initial levels of public investment in government expenditure. As the ratio increases, a diminishing return kicks in beyond a threshold, probably because an excessive crowding out of current expenditure can undermine provisions of other public goods and services, including the maintenance of existing public infrastructure.
- The inverted U-shaped relationship between the share of public investment in total expenditure and growth holds during good times and consolidation periods, with the difference being that, at a given share of public investment, predicted growth is obviously lower in bad times than in good times. This gap phases out as the initial share of public investment increases.

These findings have important policy implications. First, preserving capital spending during a time of consolidation is critical to spurring medium- and long-term growth, and is a key ingredient for a successful and sustainable consolidation. This is particularly relevant for low-income developing countries, which typically have a low ratio of public investment to total spending, and where a growth-friendly consolidation is needed when fiscal sustainability is at stake. Moreover, for these countries, protecting public investment spending in good times is equally as important as in bad times. Nevertheless, it is also important to factor in political economy considerations given that shortsighted policymakers may be tempted to maintain current expenditure because the adverse effects on short-term growth from cutting public investment are limited, even as beyond their horizons this strategy carries very high medium- to long-term costs. As a result, the appropriate expenditure mix should carefully balance the need to support medium- and long-term growth with that of minimizing the negative short-term impact on growth.

ANNEX 6.1. MODEL DESCRIPTION AND CALIBRATION

A dynamic stochastic general equilibrium model with an infinitely lived forward-looking representative household was used to analyse the data collected for this chapter. The household in turn owns a representative firm employing labor and renting capital to use as factors for production. The government raises revenues through taxes to finance public expenditures in the forms of current productive expenditure and public investment in infrastructure. The model is solved in a decentralized competitive equilibrium by log-linearization around a deterministic steady state.

Annex Table 6.1.1 presents the different parameter values used for the policy simulation. The model is calibrated for a hypothetical economy featuring many characteristics of developing countries. Whereas some parameters are borrowed from previous studies, others are derived from data used in the empirical section.

- The discount rate is set to 0.9, corresponding to a risk-free yearly rate of around 11 percent, and the constant relative risk aversion is set to be equal to 2.5; both are standard measures in the range found in the literature.
- Capital share is set to 0.45, to be consistent with the literature tackling developing countries (for example, García-Cicco, Pancrazi, and Uribe 2010; and Berg and others 2013).
- Government spending to GDP and public investment to government spending are set at 26.5 percent and 24.2 percent, respectively, to match the averages for developing countries using the data set described in the empirical section below.
- Also, the depreciation rate of private capital is set at 0.0985 to target the developing countries' average private investment to GDP of 14.8 percent using the same data set. This depreciation rate also matches the rates used by Berg and others (2013) and yields—along with the risk-free rate—a net rate of return to capital of around 21 percent. That is in the estimated range found for developing countries by Chou, Izyumov, and Vahaly (2016). As for the depreciation of public capital, it is set to be equal to 0.07 to reflect the lower depreciation rate of public capital relative to private capital and to fit the range considered by the literature.

ANNEX TABLE 6.1.1.

Parametrization

Parameter	Description	Value
β^d	Discount rate	0.9
σ	Constant relative risk aversion	2.5
μ	Capital share	0.45
g_y	Government spending to GDP	26.5%
I^g/G	Public investment to government spending	24.2%
δ	Depreciation rate of private capital	0.0985
δ^g	Depreciation rate of public capital	0.07
α	Production elasticity to public capital	0.12
β	Production elasticity to public consumption	0.04
τ^k	Capital tax	30%
τ^c	Consumption tax	16%
ρ	Persistence of government spending shock	0.9

Source: IMF staff.

- Arslanalp and others (2010) reviewed the literature on public capital and growth. They estimated the production function for countries in the Organisation for Economic Co-operation and Development compared with those outside the group and found a year-over-year production elasticity of 0.12 for OECD countries.[10] This estimate also fits the range used in the literature tackling developing countries. Also, the model adds a productive public current expenditure; the elasticity of production is set so this component of government spending is one-third that of public capital, to reflect its lower productivity.
- The capital tax rate is set to 30 percent and the consumption tax rate is set to 16 percent to be consistent with corporate tax rates and VAT rates in developing countries, particularly in low-income countries. The labor income tax rate is set to balance the budget in a steady state.

ANNEX 6.2. DATA AND EMPIRICAL MODEL SPECIFICATION

Data are used for a sample of 155 developing countries over 1960–2017 (see Annex Tables 6.2.1 and 6.2.2) to estimate the following model:

$$g_{it} = \alpha_i + \alpha_t + \alpha_j + \beta_1 \frac{P^I_{it}}{G_{it}} + \beta_2 \frac{G_{it}}{Y_{it}} + \gamma FISCSPC + \phi MACROSTAB + \eta SHOCK + \partial_1 \frac{P^I_{it}}{G_{it}} \times SHOCK + \xi_{it} \quad (6.2.1)$$

The dependent variable g_{it} is a five-year forward-moving average of real per capita GDP growth. The moving average is constructed by attaching different weights to different years. The fourth and fifth years are given relatively higher weights (31.25 percent) compared to the first three years (each 12.5 percent) to account for lags between public investment and capital buildup. The left-hand side variables include country and time fixed effects α_i and α_t, the public investment share

ANNEX TABLE 6.2.1.

Data Sources

Variable	Data Source
Public investment, % of government expenditure	Fiscal Affairs Department Capital Stock Data Set
Government expenditure, % of GDP	World Economic Outlook
Government stability	World Bank Governance Indicators
Current account balance, % of GDP	International Financial Statistics
International debt issues, % of GDP	Financial Soundness Indicators
Central bank assets, % of GDP	Financial Soundness Indicators
Private investment, % of GDP	World Bank Data
Inflation	World Economic Outlook
Real effective exchange rate change, year-over-year	International Financial Statistics
Gross debt, % of GDP	World Economic Outlook

Source: IMF staff.

[10] Arslanalp and others (2010) estimated the production function's elasticity to public capital using 1- and 10-year specifications. They estimated an elasticity of 0.12 in the short-term specification and 0.26 in the long-term one for non-OECD countries, and 0.13 and 0.08, respectively, for OECD countries.

ANNEX TABLE 6.2.2.

Emerging Market and Developing Economies Sample

East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean		Middle East and North Africa	South Asia	Sub-Saharan Africa	
Brunei Darussalam	Albania	Anguilla	Paraguay	Algeria	Afghanistan	Angola	Madagascar
Cambodia	Armenia	Antigua and	Peru	Bahrain	Bangladesh	Benin	Malawi
China	Azerbaijan	Barbuda	St. Kitts and Nevis	Djibouti	Bhutan	Botswana	Mali
Fiji	Belarus	Argentina	St. Lucia	Egypt	India	Burkina Faso	Mauritania
Indonesia	Bosnia and Herzegovinia	The Bahamas	St. Vincent and the Grenadines	Iran	Maldives	Burundi	Mauritius
Kiribati	Bulgaria	Barbados	Suriname	Iraq	Nepal	Cabo Verde	Mozambique
Lao P.D.R.	Croatia	Belize	Trinidad and Tobago	Jordan	Pakistan	Cameroon	Namibia
Malaysia	Georgia	Bolivia	Uruguay	Kuwait	Sri Lanka	Central African	Niger
Marshall Islands	Hungary	Brazil	Venezuela	Lebanon		Republic	Nigeria
Micronesia	Kazakhstan	Chile		Libya		Chad	Rwanda
Mongolia	Kosovo	Colombia		Morocco		Comoros	Senegal
Myanmar	Kyrgyz Rep.	Costa Rica		Oman		Republic of Congo	Seychelles
Nauru	FYR Macedonia	Dominica Rep.		Qatar		Democratic Republic	Sierra Leone
Palau	Moldova	Dominica		Saudi Arabia		of the Congo	Somalia
Papua New Guinea	Montenegro	Ecuador		Syria		Côte d'Ivoire	South Africa
Philippines	Poland	El Salvador		Tunisia		Equatorial Guinea	South Sudan
Samoa	Romania	Grenada		United Arab		Eritrea	Sudan
Solomon Islands	Russian Federation	Guatemala		Emirates		Eswatini	São Tomé and Príncipe
Thailand	Serbia	Guyana		Yemen		Ethiopia	Tanzania
Timor-Leste	Tajikistan	Haiti				Gabon	Togo
Tonga	Turkey	Honduras				The Gambia	Uganda
Tuvalu	Turkmenistan	Jamaica				Ghana	Zambia
Vanuatu	Ukraine	Mexico				Guinea	Zimbabwe
Vietnam	Uzbekistan	Nicaragua				Guinea-Bissau	
		Panama				Kenya	
						Lesotho	
						Liberia	

Source: IMF staff.

of government expenditure $\frac{P^I_{it}}{G_{it}}$, the GDP share of government spending $\frac{G_{it}}{Y_{it}}$, and sets of controls for "fiscal space" *FISCSPC* and "macro-stability" *MACROSTAB*. *SHOCK* is a dummy variable capturing episodes of fiscal consolidation when the primary balance improved by a threshold amount.

A forward-moving average of per capita real GDP growth is chosen as the dependent variable to capture both the contemporaneous and medium-term growth spurts associated with fiscal adjustments (such as spending mix during consolidation).[11] The impact on growth of such changes to the spending mix are likely to depend on the availability of fiscal space and the health of macro fundamentals and, broadly, the domestic policy stance over the fiscal cycle. The model accounts for this by including two broad groups of control variables denoted, respectively, "fiscal space" and "macro-stability."

Key components of fiscal space include debt sustainability, balance sheet composition, external private sector debt, and market access (IMF 2018). Two variables in the empirical model capture at least three of these dimensions (the current account balance and central bank assets as shares of GDP). The first measures the extent to which governments can flexibly meet domestic consumption and investment requirements. The second measures the macroeconomic and financial stability provided by central balance sheets. On the one hand, where payment technology is heavily reliant on currency (rather than e-transfers), central bank assets are an important buffer to meet payment obligations. This is especially true in low-income developing countries. On the other hand, because asset-side buildup of central bank balance sheets needs to be balanced by an increase in domestic liabilities, there is a chance that some of the benefits gained from asset buildup are offset by some loss in domestic financial intermediation.

The degree to which economies reduce vulnerability to external shocks to a minimum has desirable implications for sustained growth. A wide body of historical evidence ascribes long bouts of low growth and volatility in developing countries to the absence of macroeconomic stability. For the purposes of the study, the stability of macroeconomic outcomes is gauged by a set of controls, including inflation, change in the real exchange rate, and government debt (percentage of GDP).

The model incorporates two variables of interest: the share of public investment in total government spending and an indicator of fiscal consolidation episodes. The underlying idea is to see if differences in the composition of spending matter when fiscal control needs to be restored to that of good times. To ensure that the model specifically captures the impact of changing the public spending mix, the size of total public spending as a ratio to GDP and a range of country and time fixed effects are also controlled for.

Furthermore, fiscal consolidation episodes are incorporated with the dummy variable *SHOCK*. Two definitions are considered, drawing on recent literature (Von Hagan, Hughes Hallet, and Strauch 2002; Adam and Bevan 2003; Gupta and others 2005). First, a fiscal consolidation period is defined as events when

[11] This approach is consistent with Devarajan, Swaroop, and Zou (1996); Ghosh and Gregoriou (2008); and Afonso and Alegre (2011).

primary balances tightened by at least 1 percent of GDP in two successive years after the primary deficit grew beyond 3 percent of GDP. The second definition considers any reduction in the primary deficit in two consecutive years after a deficit of 1.5 percent of GDP or higher.

Additional fixed effects α_j are included to capture state dependence of medium growth performance. These include fragile country fixed effects, commodity exporter fixed effects, and IMF income group fixed effects. These fixed effects account for *peace dividends* in postconflict economies, and conditional convergence and structural growth volatility in resource-dependent economies.

ANNEX 6.3. GROWTH EFFECTS FROM CHANGING COMPOSITIONS OF SPENDING

ANNEX TABLE 6.3.1.

Growth Effects from Composition of Spending

	(1)	(2)	(3)	(4)	(5)
Public investment, % of government expenditure	0.06***	0.13***	0.14***	0.14***	0.13***
	(0.010)	(0.043)	(0.044)	(0.040)	(0.038)
(Public investment, % of government expenditure)^2		−0.00*	−0.00**	−0.00***	−0.00***
		(0.001)	(0.001)	(0.001)	(0.001)
Government expenditure, % of GDP			0.01	0.02	0.04*
			(0.019)	(0.018)	(0.019)
Government stability			0.17***	0.14***	0.12***
			(0.044)	(0.043)	(0.047)
Current account balance, % of GDP				−0.03**	−0.00
				(0.016)	(0.017)
Central bank assets, % of GDP				−0.11***	−0.05
				(0.030)	(0.032)
Private investment, % of GDP					0.06***
					(0.020)
Inflation					−0.01
					(0.011)
Real effective exchange rate change, year-over-year					0.01
					(0.009)
Gross debt, % of GDP					−0.02***
					(0.005)
Constant	0.85***	0.10	−1.36*	−0.70	−1.10
	(0.232)	(0.502)	(0.772)	(0.807)	(0.950)
No. of observations	2,969	2,969	2,253	1,984	1,681
R^2	0.52	0.52	0.54	0.58	0.64
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
IMF income fixed effects	Yes	Yes	Yes	Yes	Yes
Commodity exporter fixed effects	Yes	Yes	Yes	Yes	Yes
Fragile fixed effects	Yes	Yes	Yes	Yes	Yes
Maximum inverse U-curve	—	47.11	36.58	33.34	34.25
U-test (P>|t|)	—	—	0.237	0.085	0.117

Source: IMF staff.
Note: The dependent variable is a forward-moving average of per capita real GDP growth. Robust standard errors appear in parentheses. The hypotheses of the inverse U-test are as follows: H_o: relationship is monotonic or U-shaped; H_1: relationship is inverse U-shaped. The maximum inverse U-curve is the threshold at which increasing the share of investment has no growth benefits. The U-test determines whether the threshold is statistically significant. IMF income group fixed effects are dummies for low-income developing countries and emerging market economies. The fragility fixed effects row captures countries with Country Policy and Institutional Assessment scores of 3 or lower.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

ANNEX TABLE 6.3.2.

Composition of Spending during Fiscal Consolidation				
	(1)	(2)	(3)	(4)
Public investment, % of government expenditure	0.12***	0.13***	0.13***	0.12***
	(0.043)	(0.044)	(0.039)	(0.037)
(Public investment, % of government expenditure)^2	–0.001	–0.002**	–0.002**	–0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Consolidation	–2.63***	–2.91***	–3.33***	–2.50***
	(0.669)	(0.756)	(0.813)	(0.553)
Public Investment × Consolidation	0.18***	0.19***	0.26***	0.19***
	(0.060)	(0.067)	(0.070)	(0.054)
Public Investment^2 × Consolidation	–0.003**	–0.003**	–0.004***	–0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Government expenditure, % of GDP		0.01	0.02	0.03*
		(0.019)	(0.018)	(0.019)
Government stability		0.17***	0.13***	0.12***
		(0.043)	(0.042)	(0.046)
Current account balance, % of GDP			–0.03*	–0.001
			(0.016)	(0.017)
Central bank assets, % of GDP			–0.11***	–0.05
			(0.030)	(0.032)
Private investment, % of GDP				0.06***
				(0.020)
Inflation				–0.01
				(0.012)
Real effective exchange rate change, year-over-year				0.01
				(0.009)
Gross debt, % of GDP				–0.02***
				(0.005)
Constant	0.28	–1.14	–0.54	–0.97
	(0.500)	(0.765)	(0.786)	(0.931)
No. of observations	2,969	2,253	1,984	1,681
R^2	0.52	0.54	0.59	0.64
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
IMF income fixed effects	Yes	Yes	Yes	Yes
Commodity exporter fixed effects	Yes	Yes	Yes	Yes
Fragile fixed effects	Yes	Yes	Yes	Yes

Source: IMF staff.
Note: The dependent variable is a forward-moving average of per capita real GDP growth. "Fiscal consolidation" is defined as a total of 1 percent GDP reduction in the primary deficit in two consecutive years after a fiscal deficit of 3 percent of GDP or higher. Robust standard errors appear in parentheses. IMF income group fixed effects are dummies for low-income developing countries and emerging market economies. The fragile fixed effects row captures countries with Country Policy and Institutional Assessment scores of 3 or lower.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

ANNEX TABLE 6.3.3.

Composition of Spending and Growth during Good and Bad Times: Additional Control Variables

	(1)	(2)	(3)	(4)
Public investment, % of government expenditure	0.12***	0.16***	0.16***	0.16***
	(0.043)	(0.061)	(0.061)	(0.049)
(Public investment, % of government expenditure)^2	–0.00	–0.00**	–0.00**	–0.00**
	(0.001)	(0.001)	(0.001)	(0.001)
Consolidation	–2.63***	–2.64**	–3.24***	–2.14***
	(0.669)	(1.026)	(1.014)	(0.810)
Consolidation × Public Investment, % of Government Expenditure	0.18***	0.23**	0.30***	0.23***
	(0.060)	(0.094)	(0.097)	(0.073)
Consolidation × (Public investment, % of government expenditure)^2	–0.00**	–0.00**	–0.01***	–0.00***
	(0.001)	(0.002)	(0.002)	(0.001)
Government expenditure, % of GDP		–0.00	0.01	0.02
		(0.027)	(0.027)	(0.024)
Government stability		0.19***	0.18***	0.14***
		(0.063)	(0.056)	(0.049)
Human Capital Index		0.05	0.37	1.63
		(2.195)	(2.170)	(1.821)
Financial depth		0.07*	0.07*	0.08***
		(0.035)	(0.037)	(0.028)
Trade openness		0.00	0.01	0.00
		(0.008)	(0.007)	(0.007)
Current account balance, % of GDP			0.01	0.01
			(0.021)	(0.023)
Central bank assets, % of GDP			–0.00	0.06
			(0.059)	(0.053)
Private investment, % of GDP				0.03
				(0.029)
Inflation				0.01
				(0.016)
Real effective exchange rate change, year-over-year				0.01
				(0.009)
Gross debt, % of GDP				–0.03***
				(0.006)
Constant	0.28	–2.22	–3.30	–5.40
	(0.500)	(5.409)	(5.338)	(4.527)
No. of observations	2,969	840	792	766
R^2	0.52	0.72	0.74	0.78
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
IMF income fixed effects	Yes	Yes	Yes	Yes
Commodity exporter fixed effects	Yes	Yes	Yes	Yes
Fragile fixed effects	Yes	Yes	Yes	Yes

Source: IMF staff.
Note: Robust standard errors appear in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

ANNEX TABLE 6.3.4.

Robustness Test with Second Definition of Consolidation

	(1)	(2)	(3)	(4)
Public investment, % of government expenditure	0.12***	0.13***	0.16**	0.18***
	(0.042)	(0.044)	(0.063)	(0.064)
(Public investment, % of government expenditure)^2	–0.00	–0.00**	–0.00*	–0.00**
	(0.001)	(0.001)	(0.001)	(0.001)
Consolidation	–1.74***	–1.92***	–2.44**	–1.15
	(0.512)	(0.586)	(0.922)	(0.809)
Public investment consolidation	0.11**	0.11**	0.16*	0.05
	(0.046)	(0.053)	(0.079)	(0.067)
(Public Investment)^2 × Consolidation	–0.00*	–0.00	–0.00	–0.00
	(0.001)	(0.001)	(0.001)	(0.001)
Government expenditure, % of GDP		0.01	0.01	0.05*
		(0.019)	(0.029)	(0.028)
Government stability		0.17***	0.14**	0.15***
		(0.043)	(0.056)	(0.053)
Current account balance, % of GDP			–0.05*	–0.01
			(0.024)	(0.025)
International debt issues, % of GDP			–0.04**	–0.04**
			(0.015)	(0.017)
Central bank assets, % of GDP			–0.14***	–0.07*
			(0.046)	(0.037)
Private investment, % of GDP				0.07*
				(0.037)
Inflation				–0.02
				(0.017)
Real effective exchange rate change, year-over-year				0.02
				(0.012)
Gross debt, % of GDP				–0.03***
				(0.009)
Constant	0.28	–1.09	0.20	–1.10
	(0.492)	(0.766)	(1.310)	(1.559)
No. of observations				
R^2	2,969	2,253	991	884
Country fixed effects	0.52	0.54	0.62	0.68
Year fixed effects	Yes	Yes	Yes	Yes
IMF income fixed effects	Yes	Yes	Yes	Yes
Commodity exporter fixed effects	Yes	Yes	Yes	Yes
Fragile fixed effects	Yes	Yes	Yes	Yes

Source: IMF staff.

Note: The dependent variable is a forward-moving average of per capita real GDP growth. "Fiscal consolidation" is defined as any reduction in the primary deficit in two consecutive years after a fiscal deficit of 1 percent of GDP or higher. Robust standard errors appear in parentheses. IMF Income group fixed effects are dummies for low-income developing countries and emerging market economies. The fragile fixed effects identify countries with Country Policy and Institutional Assessment scores of 3 or lower.

***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

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