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The Growth and Distributive Impacts of Public Infrastructure Investments in the Philippines

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Abstract

This study investigates the role of public infrastructure investment on economic growth and poverty reduction in the Philippines. Using a dynamic general equilibrium-microsimulation model that explicitly models public capital as a production input, we find that the positive supply side effects of higher public investment expenditure manifest over time, through higher capital accumulation and improved productivity. Our findings reveal that higher public infrastructure investment not only positively impacts real GDP, but also reduces poverty and inequality in the short and long run. In this context, the Philippine government needs to become more proactive in finding ways to finance higher public investment expenditures. This is especially relevant with respect to international financing, given the narrow tax base in the country. Our simulation results confirm that international financing is a better alternative than tax financing when considered in terms of its ability to improve the economy's physical infrastructure in order to create job opportunities, improve productivity and complement its social protection measures.

Keywords: Computable general equilibrium, intertemporal choice and growth, public infrastructure investment, growth strategy, microsimulation, Philippines

JEL codes: D58, D90, E27, F35, F43, I32, O16, O53

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1. INTRODUCTION

The government of the Philippines continues to implement reforms that aim to promote economic development and lift the country's standard of living. This is critical as it has been lagging behind neighbouring East Asian countries with respect to economic size and per capita income.[1]The bottlenecks the country faces include poor physical infrastructure (transport and utility infrastructures), low quality of education, volatile economic growth, high poverty rates and large income disparities.

Various business surveys have pointed to the relatively poor quality of transportation infrastructure in the country, such as airports, maritime ports, roads and railroads. Energy and water infrastructures have also not been fully developed, and concerns over a possible crisis in power and water have recently mounted. Public spending on education has also been criticized as being low compared to neighbouring countries in the region, resulting in a weak public education system.

Against this backdrop, the government of the Philippines has engaged in policy measures to improve the quality of public infrastructure (especially in relation to transport and utilities) and public education in order to ensure and sustain robust growth and to alleviate poverty. To speed up public infrastructure development in the presence of fiscal constraints, the government has revived the promotion of partnerships with the private sector (in Build-operate-transfer schemes), with the private sector providing financial and technical expertise for selected infrastructure projects.

This paper contributes to policy analysis in the Philippines by providing a quantitative assessment of the growth and distributive impacts of increasing spending on public infrastructure, such as in transportation, utilities and education. Since these issues are interlinked, a computable general equilibrium (CGE) model is employed together with a micro-simulation model in order to trace the channels whereby public infrastructure investments filter through the Philippine economy. We use Philippine data in a dynamic CGE model developed by Dissou and Didic (2011) which explicitly models public capital as an input in firms' production process. The results of the CGE simulations are then used as inputs into a micro-simulation module following Cockburn, Duclos and Tiberti (2011) in order to assess the distributive impacts of an increase in public infrastructure investments.

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[1] Based on the World Bank's World Development Indicators database, 2009 Philippine GDP, at constant 2000 prices and adjusted for purchasing power parity (PPP), stood at US$295.8 billion. This is lower than in most other East Asian countries, including the People's Republic of China or PRC (US$8.2 trillion), Indonesia (US$877 billion), Japan (US$3.8 trillion), Republic of Korea (US$1.2 trillion), Malaysia (US$348.2 billion) and Thailand (US$491.8 billion). This contrasts with the situation, in 1980, when Philippine PPP-adjusted real GDP was US$126 billion, much higher than Malaysia (US$67.3 billion) and Thailand (US$105.4 billion). Moreover, the PPP-adjusted GDP per capita at 2005 prices for the Philippines was US$3,216, lower than in the PRC (US$6,200), Indonesia (US$3,813), Japan (US$29,688), Korea (US$25,493), Malaysia (US$12,678), Singapore (US$45,978) and Thailand (US$7,258).

To provide input to policy makers, we conduct two experiments to assess the potential immediate, short-run and long-run effects of increased public investment expenditures, when financed by either higher taxes or foreign borrowing. The policy focus of this paper leads us to stay within the confines of attainable government policies by simulating a 25 percent permanent increase in the public infrastructure expenditures-to-GDP (PIE-GDP) ratio over time. This increase is sufficient to achieve the government's minimum target of a 5 percent PIE-GDP ratio.

The next sections are as follows. Section 2 provides a brief survey of the public investment literature and section 3 discusses issues relating to public infrastructure in the Philippines. Section 4 presents a poverty profile of the Philippines. Section 5 describes the CGE model and the micro-simulation module, then sections 6 and 7 respectively explain the simulation scenarios and the simulation results. Finally, section 8 provides insights and conclusions.

2. PUBLIC INFRASTRUCTURE

Empirical research on the economic impact of public infrastructure is now widespread. One strand in the literature makes use of econometric modeling techniques. In a seminal paper, Aschauer (1989) uses an OLS approach to show that the capital stock of public infrastructure is a determinant of total factor productivity in the United States. Isaksson (2009) adopts a panel data regression model—using ordinary least squares (OLS), both fixed and random effects, and instrumental variables—to analyze a group of 57 advanced and developing countries over 1970-2000. His research finds that public capital has a relatively strong impact on industrial development and that public capital growth has the strongest impact on rapidly growing economies and high-income economies.

Calderon and Chong (2004) use a generalized method of moments (GMM) dynamic panel estimation model to capture the role of the volume and quantity of infrastructure—particularly in energy, public works, railways, roads and telecommunications—on income distributions in a set of 101 countries over 1960-1995. Their study reveals a negative relationship between the level of infrastructural development and income inequality. Arslanalp, Bornhorst and Gupta (2011) use a production function with estimated public capital in 48 advanced and developing economies over 1960-2001. They find that increases in the stock of public capital are associated with economic growth, with advanced economies registering stronger short-run effects and developing economies having greater long-run effects. Gupta et al (2011) adopt a production function approach with a GMM estimation. They use efficiency-adjusted public capital stock data for 52 developing countries, and find that this type of public capital has a significant effect on output.

Other related studies have opted for general equilibrium techniques. Zhai (2010) uses a global CGE model, and finds that regional infrastructure investment in developing Asia would raise global income by US$1.8 trillion by the year 2020, with 90% of the gains accruing to the region. Moreover, such investment would help boost global and regional trade. Dissou and Didic (2011)

use a CGE model with heterogeneous agents and public capital in a multi-sectoral and intertemporal environment calibrated to the economy of Benin. They show, among other things, that: increasing public investment has short-run Dutch disease effects, expected to be offset by increased productive capacity in the long run; higher public infrastructure spending benefits non-constrained agents more than constrained agents; and that the short-run private sector investment response depends on how the public infrastructure is financed.

Unfortunately, empirical research on the role of infrastructure spending on economic growth and poverty in the Philippines—a developing economy in Southeast Asia—is limited. Teruel and Kuroda (2005) use a translog cost function to find that improvements in public infrastructure in the Philippines—particularly road infrastructure—are instrumental in enhancing agricultural productivity in the country. Savard (2010), using a top-down bottom-up computable general equilibrium (CGE) micro-simulation model, demonstrates the macro, sectoral and poverty impacts of increasing public investment in the Philippines. The findings indicate that: public investment positively impacts GDP and employment; the macro effects do not differ substantially across the three public investment financing mechanisms considered (income tax, value-added tax (VAT) and foreign aid); public investment lowers poverty; that public investment lowers poverty – the magnitude being strongest under VAT; and that foreign aid is the most equitable funding mechanism.

A contentious empirical issue is the estimation of the elasticity of output to public capital, which has been criticized in several studies as being too high, as a result of some methodological limitations or weaknesses. Isaksson (2009) points out that this concern arose because Aschauer's (1989) estimate of the effect of public investment is impossibly large, ranging from 0.38 to 0.56, implying an annual rate of return of no less than 100 percent. Potential sources of this problem vary and those cited in the literature include endogeneity, reverse causality (from output growth to public capital), spurious correlation (due to non-stationarity of the data), omitted state-dependent variables and lack of agreement regarding the appropriate rate of return from public investment.

Furthermore, it has been conjectured that the large estimates on the elasticity of output to public capital could emanate from: high public investment (as a proportion of GDP), a situation which is prevalent in highly corrupt countries, as corruption tends to inflate public investments; from unproductive uses in public capital; and from the composition of public capital. Several papers have attempted to correct for these econometric and conceptual problems by accounting for the elasticity of output to public capital, including Arslanalp, Bornhorst and Gupta (2011), Gupta et al (2011) and Isaksson (2009).

3. PUBLIC INFRASTUCTURE CHALLENGES

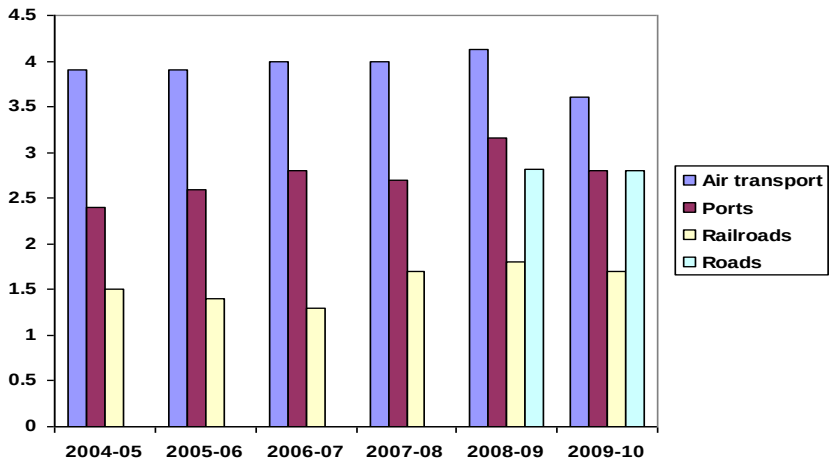
It has been widely perceived that Philippine transport infrastructure—air transport, ports, railroads, roads—is of poor quality and has not improved much in recent years. The latest World Economic Forum's (WEF) Executive Opinion Survey, published in its Global Competitiveness

Report (GCR) 2010-11, ranked the Philippines 113th out of 139 countries in the overall quality of its infrastructure, giving the country a score of 3.2; the possible score ranges from 1 (worst) to 7 (best). More specifically, the Philippines ranked 97th in railroad infrastructure, 112th in air transport infrastructure, 114th in road infrastructure and 131st in port infrastructure. This suggests that, by international standards, the overall quality of Philippine infrastructure is relatively poor. Indeed, figure 1 confirms that, between 2004 and 2010, infrastructure indicator scores deteriorated slightly in relation to air transport, ports and railroads, while the score on road infrastructure remained unchanged.

3.1 Infrastructure trends

The road network in the Philippines expanded during the 1990s, then began to deteriorate, falling to 200,037 kilometres in 2003 (the most recent data available) from 202,123 kilometres a year earlier. The proportion of paved roads in the national road network climbed during the mid-1990s, rising to 19.8 percent in 1998, but then fell to 9.9 percent in 2002. The length of rail lines stagnated between 1990 and 2008: the country had 479 kilometres of rail in the early 1990s, a number that increased to 491 kilometres by 2004 and eventually fell back to 479 kilometres by 2008.

Figure 1. World Economic Forum's Executive Opinion Survey scores on transport infrastructure indicators in the Philippines, 2004-2010



Source: World Economic Forum, Global Competitiveness Report, various issues

The Philippines also ranked relatively low (101st of 139 countries) in the 2010-11 WEF Executive Opinion Survey in terms of the quality of electricity supply, garnering a score of 3.4 (the possible score ranges from 1 [insufficient] to 7 [sufficient and reliable]). Concerns over a looming power shortage or crisis in the country were evident in 2010 amid intermittent power outages, particularly in the southern part of the archipelago (Mindanao), as widespread droughts caused by El Nino—which resulted in receding water reservoirs in hydroelectric dams—coupled with poor maintenance work, have led to inadequate power supply. At that same time, the disruptive weather

had resulted in surging peak demand (DOE 2010). Moreover, structural reforms in the power sector have faced bottlenecks, and not enough new power capacity has come online in the country. Obstacles to power sector reforms include delays in the privatization of the government's power generation assets—such as power plants, particularly those from the state-owned National Power Corporation— hampering the rehabilitation of these assets and limiting the participation of the private sector in the electricity supply industry.

Moreover, power supply in the Philippines is geographically concentrated in a few areas, further contributing to the problem of inadequate power capacity. In a recent assessment of the Philippines' power situation, the Department of Energy (DOE) of the Philippine government reported that: i) In the country's Luzon region, the power generation capacity has been concentrated in the Northern and Southern areas, with relatively large power loads in Metro Manila and neighbouring provinces; ii) Power generation capacity in the Visayas region has been concentrated in the Leyte-Samar grid; and iii) In Mindanao, most of the power generation capacity is located in the Northern areas but the bulk of electricity demand comes from the Southern areas.

As electricity demand continues to increase (see Appendix, figure A1), there is an urgent need to create more energy-related infrastructure in order to increase the country's power generation capacity. Over 2010-2013, the DOE together with power firms plan to build four coal-fired plants across the archipelago. Furthermore, the DOE has projected that the Luzon, Visayas and Mindanao power grids would respectively need an additional capacity of 11,900 megawatts (MW), 2,150 MW and 2,500 MW of capacity by 2030.[2]

Access to water seems to have marginally improved over the years in the Philippines (see Appendix, figure A2). The proportion of the overall population in the country with access to an improved water source has climbed gradually, from 84 percent in 1990 to 87 percent in 1995, 88 percent in 2000, 90 percent in 2005 and 91 percent in 2008. Urban dwellers generally have better access to an improved water source than those in rural areas. The share of the urban population with access to an improved water source remained unchanged at 93 percent, while the situation improved consistently in rural areas from 76 percent in 1990 to 87 percent in 2008.

Despite improved water access, there is still a need for the Philippine government to further expand water distribution and improve water infrastructure. The government has admitted that there are certain challenges in the water sector such as: water depletion in major cities, including Metro Manila and Metro Cebu; rampant water pollution; increasing demand for water; low willingness to pay for water; low cost recovery of investments; and institutional problems.

[2]Ibazeta, 2010. The Power Outlook. Presentation to the Philippine Economic Society, Makati City.

3.2 Government policy on infrastructure

The Philippine Infrastructure Public-Private Partnership (PPP) program is the flagship policy agenda of the government in promoting infrastructure development in the country. The PPP recognizes the private sector's role as a catalyst of growth and as an important source of infrastructure financing. Infrastructure projects covered by the PPP program include those that aim to develop the agri-business, educational, energy, environment, health, industry, information and communications technology, logistics, property, transportation, telecommunications and water supply sectors.

The Medium Term Philippine Development Plan (MTPDP) 2004-2010 reported that the Philippine government will prioritize transportation infrastructure-related projects that boost the country's trade and investments. These projects include construction of roads and railroads that will decongest the country's capital (Metro Manila), major highways, roads and airports connecting tourism hubs, and roll-on roll-off (RORO) ports. The government aims to boost infrastructure spending in the country through the Comprehensive and Integrated Infrastructure Program (CIIP). The CIIP anticipates that the private sector would bring PHP400.9 billion in infrastructure financing, with PHP214.4 billion in the transport sector, PHP112.3 billion in water supply, PHP70.7 billion in social infrastructure and PHP3.5 billion in telecommunications.[3]

Table 1 shows the annual sectoral breakdown of planned infrastructure investment in the Philippines starting in 2009 and through to 2013 and beyond. Total planned infrastructure spending in 2011 is 32.2 percent lower than in the previous year, at PHP564.9 billion (5.8% of GDP); the power sector was expected to have the largest allocation at PHP246.9 billion (43.7 percent of total), followed by the transportation sector at PHP133.2 billion (23.6 percent of total). Infrastructure investments are planned to be 18.7 percent higher in 2012 on a year-on-year basis, at PHP670.7 billion (6.9% of GDP), and the largest chunk of investments (36.9%) in 2012 was to be targeted to government support for agrarian reform communities (ARCs). In 2013, the government plans lower infrastructure investments of PHP307.6 billion (3.2% of GDP), with the power sector receiving the greatest share of the total, at PHP94.7 billion (30.8 percent of total). Beyond 2013, it is estimated that about PHP625 billion (6.4% of GDP) will be spent on infrastructure, with power, water and transportation being the largest recipients.

In 2010, the Philippine government's expenditures (excluding interest payments and spending on financial services) totalled PHP1,379.3 billion, of which 36.3 percent were on goods and services from production sectors, 33.8 percent on social services, 24.5 percent on general public

[3] Paderanga, C. 2010.The Philippine Economy: Performance, Prospects, Challenges, and Strategies. Presentation at the House of Representatives, Quezon City, Philippines.

services and 5.3 percent on national defence.[4] The largest single focus of public spending was education, at 17.4 percent of public spending (PHP240.6 billion), followed by transport and telecommunications infrastructure (12.6 percent, PHP174.3 billion). However, public spending on health-related infrastructure and on electricity/energy-related infrastructure were both relatively small, respectively at 3.7 percent (PHP50.9 billion) and 1.3 percent (PHP17.8 billion).

Table 1. Breakdown of Philippine infrastructure investment (by sector, 2009–beyond 2013, billions of pesos)

Sector	2009	2010	2011	2012	2013	Beyond 2013
Transportation	123.8	247.6	133.2	102.2	63.6	171.9
Power	85.5	196.2	246.9	150.9	94.7	230.3
Water	36.5	68.8	68.2	112.2	49.6	179.2
Telecommunications	7.9	9.8	7.3	15.5	15	0.5
Social Infrastructure	43.8	279.1	40.8	31.2	24.7	26.0
Support to ARCs	23.5	22.0	58.4	247.3	55.7	3.3
Re-lending programs	5.0	9.0	10.2	11.3	4.3	13.4
Total	**326.0**	**832.6**	**564.9**	**670.7**	**307.6**	**624.7**
% of GDP	**4.1**	**9.2**	**5.8**	**6.9**	**3.2**	**6.4**

ARCs = Agrarian reform communities, GDP = gross domestic product.
Note: 2011 nominal GDP data is used to get the share of infrastructure investment for 2012, 2013, and beyond 2013.
Source: National Economic and Development Authority (NEDA) and authors' computation.

4. PHILIPPINE POVERTY PROFILE

Based on official accounts disseminated by the National Statistics Coordination Board (NSCB) of the Philippine government, the poverty incidence (estimated using per capita income data) among the Philippine population in 2009 was estimated at 26.5 percent, which is higher than the previously estimated poverty incidences of 26.4 percent in 2006 and 24.9 percent in 2003. Philippine economic growth fluctuated during this period, with real GDP growth of 1.1 percent in 2009, 5.2 percent in 2006 and 5.0 percent in 2003. Moreover, income inequality in the country declined somewhat during this period, with the Gini coefficient falling from 0.465 in 2003 to 0.458 in 2006.

[4] Inclusive of interest payments (PHP276,212.0 million) and payments for financial services (PHP6,994.7 million), public expenditures of the Philippines in 2010 totalled PHP1,662.5 billion.

4.1 Snapshot of Philippine poverty

We now provide a description or characterization of poverty based on explicit subgroup characteristics.[5] We do this by constructing a profile pertaining to specific subpopulation characteristics in order to highlight the regional variation and urbanity differences of poverty estimates by using survey estimation techniques.[6] In constructing profiles, we consider the following attributes: (1) headship; (2) economic activities of the household head which include occupation and class of work; (3) marital status of household head; and (4) the type of household.

We estimated the poverty incidence for each of the household attributes based on data from the 2006 Family Income and Expenditure Survey (FIES). (The results are shown in the Appendix, table B1.) Figure 2 presents the poverty incidence by household type, and sex and marital status of the household head. It shows that single households or nuclear families have a higher poverty incidence (27.7 percent) than extended households (24.9 percent); this may be due to the fact that extended households have more access to resources, giving rise to relatively more reliable safety nets. This is consistent with the findings of Albert and Collado (2004) which were based on the 2000 FIES. We also find that roughly 29 percent of male-headed households are poor, whereas about 20 percent of female-headed households are poor. By marital status of the household head, the lowest poverty incidence is found among single-parent households at 17.1 percent, followed by households whose head is divorced (19.9 percent), whereas households whose heads are married have a higher poverty incidence (28.3 percent).

Estimates of poverty incidence by class of worker (household head) and number of household members employed are likewise presented in table B1 in the appendix. The literature generally finds a strong relationship between poverty status and involvement in economic activities. Our results show that households are more likely to be poor when the head is self-employed and are less so if the head works for the government. Our calculations also show that households with heads working in the public sector have a lower poverty incidence than households whose heads are working in the private sector. This can be easily explained by the fact that, on average, civil servants earn more, and more stable, income than those working in the private sector.[7] The incidence of poverty among self-employed household heads is higher than among those employed in the private sector. In fact, households whose heads are self-employed have the highest poverty incidence, at 34.7 percent; this is somewhat expected since a significant portion of the workforce is

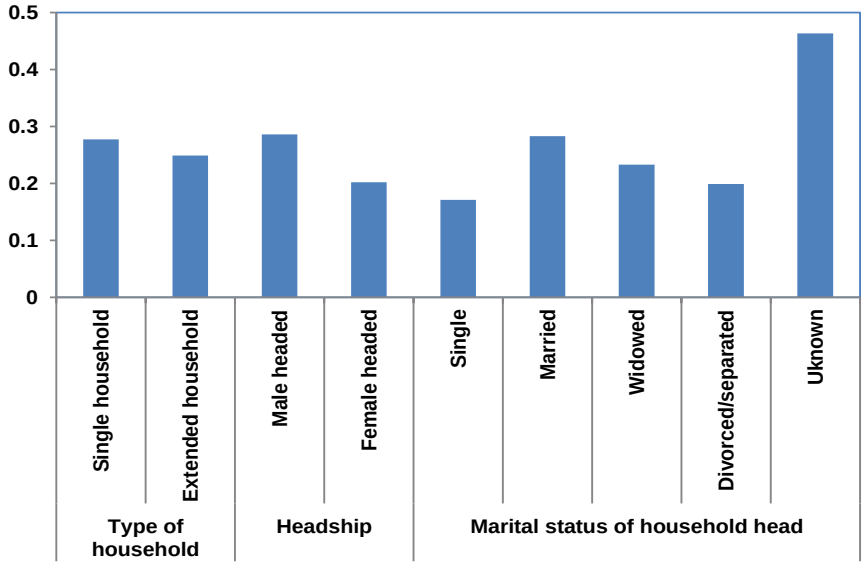
[5] We have to note that we use characteristics of the household head to characterize poverty outcomes. These include the household head's gender, marital status and the class of work. For household level attributes, we included access to electricity and existence of toilet facilities and household type.

[6] We computed preliminary estimates by using the survey's total estimation module which allowed us to compute for the total number of poor and non-poor households. The sampling weights that we use pertain to probability weights assigned to respective households. The stratifying variable that we use combined information on the province and urban/rural residence.

[7] However, we do not have evidence that private sector workers with comparable attributes relative to government workers have better compensation.

employed in the informal sector, which is dominated by unincorporated businesses. Finally, households with eight employed members have a relatively lower poverty incidence than those with less than eight employed members.

Figure 2. Poverty incidence based on type of household, sex and marital status of household head



Source: Authors' computation based on Philippine FIES 2006 (Overall)

5. METHODOLOGY

A combination of computable general equilibrium (CGE) and micro-simulation methodologies is employed to trace and understand the channels via which public infrastructure investments filter through the Philippine economy. We now briefly present the models and underlying data.

5.1 The CGE model

Using Philippine data, we employ a dynamic general equilibrium model developed by Dissou and Didic (2011) to trace the channels via which public infrastructure investments filter through the Philippine economy. To avoid repetitiveness, we only summarize the model and refer the interested reader to Dissou and Didic (2011) for the complete specifications.[8] In general, this model assumes a small open economy—consisting of households, firms and the government—that produces and consumes tradable and non-tradable goods and has access to the international capital market.

An important feature of this model is that it explicitly treats public capital as an input into the firms' production process, making it possible to quantify the growth and distributive effects of public infrastructure investments on the Philippine economy over time. In other words, public

[8] For more details of the model, please see Dissou and Didic (2011).

infrastructure investment is introduced into the model by treating public capital as an input in the production function of firms.

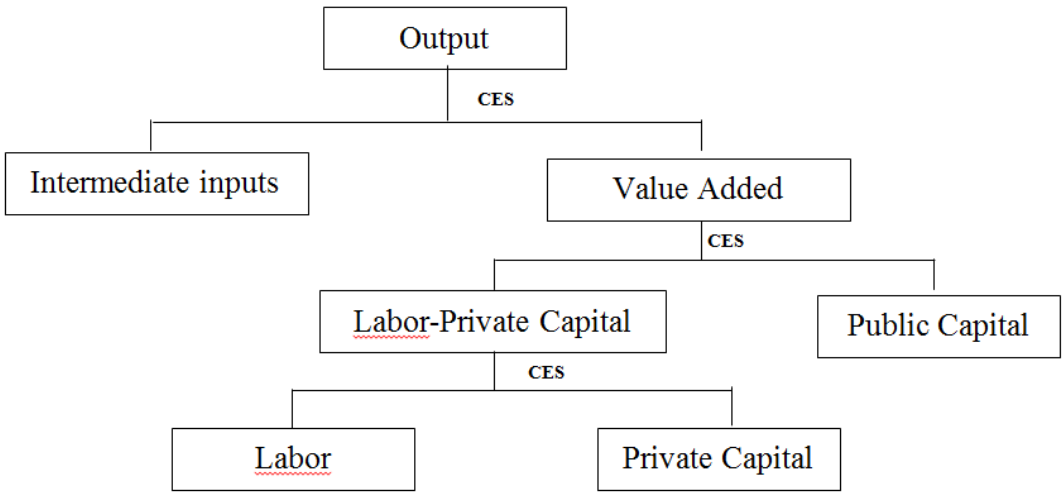
Public capital is assumed to be a pure public good[9] and enters firms' production functions as an externality that enhances output. This occurs when modeling public capital using the stock approach, with accumulated public infrastructure investment flows generating externalities on the production technology used by firms. Although data limitations mean that the model assumes only one type of public capital, productivity effects are nevertheless allowed to vary across industries. Firms in all industries make use of intermediate inputs, labour, physical capital and public capital to produce a composite output that can be sold in both domestic and international markets. However, public capital is a fixed input—as it is a government policy variable rather than a decision variable of the firm—while other inputs are controlled by the firm.

The economic intuition behind the impact of public infrastructure on economic growth in the model is as follows. In a scenario with fixed public capital and increases in other inputs—such as labour supply, physical capital and intermediate inputs—the productivity of labour and physical capital would deteriorate, thereby hurting economic growth. For example, a build-up of physical capital stocks and an accumulation of labour supply in the absence of increased public infrastructures can result in negative externalities such as through traffic congestion, deteriorating infrastructure quality, etc. In order to mitigate these negative effects on productivity and to spearhead economic growth, the stock of public capital must be increased by undertaking investments in public infrastructure.

As shown in figure 3, gross output is determined via a three-stage process. The lowest stage involves the optimal determination of labour and private capital through a constant elasticity of substitution (CES) function. The CES labour-private capital aggregate is then combined with public capital through another CES function to form a composite value added. In spite of the CES aggregator formulation, the stock of public capital is a fixed factor with endogenous rates of return reflecting its marginal product. Note that public capital is not a decision variable for the firm since public capital stocks are accumulated through public sector infrastructure investments. Finally, gross output is determined by combining the composites of value added and intermediate inputs (a Leontief function of individual intermediate inputs) through another CES function.

[9] As a pure public good, services derived from public capital are not subject to congestion.

Figure 3. Production structure



Another salient feature of the model is that it accounts for firm and household heterogeneity. Households are divided into two types: (a) constrained (myopic) households whose decisions solely depend on their current income, as they do not have access to credit. Constrained households save a constant and strictly positive fraction of their disposable income (Keynesian savings behaviour); and (b) non-constrained or forward-looking households who are capable of smoothing consumption—as they can extract savings and have access to credit in the capital market, where they can borrow and lend at a fixed world interest rate. Regardless of the household type, we assume that household labour supplies are perfectly inelastic, implying that households do not consider leisure as part of their labour supply decision. Household income sources are: wages, capital income (returns from both private and public capital) and transfers from the government and from the rest of the world. Finally, all households consume on the basis of a constant elasticity of substitution (CES) function.

Firms are also classified as constrained and non-constrained. Non-constrained firms have access to a capital market where they can borrow and lend at a fixed world interest rate and are owned by non-constrained households. They determine their optimal levels of inputs and outputs through intertemporal optimization. Constrained firms are only financed by constrained households who use their savings to purchase the capital stock of these firms. As opposed to non-constrained firms, constrained firms only maximize current profits. The government collects income taxes directly on the labour income of both non-constrained and constrained households and from the dividends of non-constrained households.

Real government spending on commodities is exogenous but grows overtime as a function of population growth and technological progress. The current public infrastructure-to-GDP ratio is exogenous. We treat this ratio as a policy variable that can be modified to perform simulations in relation to increased public infrastructure. Government savings is held fixed to ensure that the

public sector cannot increase its debt over time. Increases in public investment are either financed by a uniform increase in production tax rates imposed on firms or through an increase in foreign financing, with payments to the latter being part of foreign debt service payments in each period. The labour market behaves in a neo-classical manner with wages adjusting to ensure equilibrium on labour markets. Similarly, prices in goods markets adjust to maintain equilibrium. Total investment is financed by total savings: investment flowing to constrained firms comes from the savings of constrained households; while dividends paid by non-constrained firms to non-constrained households are net of investment expenditures. Finally, the transversality condition imposed on asset holdings ensures that the country cannot continuously increase its foreign debt, i.e., any increase in debt today must be paid for by future increases in the current account balance.

5.2 CGE data and parameters

The model uses an aggregated version of the latest available unofficial social accounting matrix (SAM) for the Philippines (Cororaton and Corong, 2009) as its principal database. There are twelve sectors in the model: i) crops and livestock; ii) other agricultural products; iii) food, alcoholic beverages, and tobacco; iv) mining; v) paper and wood; vi) petrochemicals; vii) textiles and garments; viii) heavy manufacturing; ix) light manufacturing; x) other manufacturing; xi) public services; and xii) other services. Three sectors are assumed to be comprised of constrained firms: other agriculture, other manufacturing and other services; the rest are classified as non-constrained firms.

Table 2 presents the basic structure of the Philippine economy in the base scenario, following the country's SAM. We can see in this table that the light manufacturing sector has the largest value added, investment, exports and imports of the twelve sectors, while other services mostly end up as final consumption.

Table 2. Characteristics of Philippine economy (based on 2000 Philippine SAM)

	Value added	Consumption	Investment	Government	Exports	Imports
Crops and livestock	4	3.5	4.5	0	1.2	1.9
Other agriculture	0	3.2	0.1	0	0.8	0
Food, beverage and tobacco processing	2	19.9	0.4	0	3.6	4.1
Mining	0.2	0.1	0	0	0.4	9
Paper and wood	1.7	0.7	0.3	0	2.1	1.8
Petrochemical	1.1	3.7	0.2	0	2.6	7.4
Textiles and garments	1.1	3.2	0.2	0	9.5	5.2
Heavy manufacturing	1.4	0.1	0.6	0	2.7	4.7
Light manufacturing	85.3	3	48.6	0	59.5	47.9
Other manufacturing	3.2	1	2.7	0	3	2
Public services	0	0.1	0	100	0.1	0
Other services	0	61.6	42.4	0	14.6	16

SAM = Social accounting matrix.
Source: Authors' computations.

Table 3 summarizes the CES elasticities for the production structure illustrated in figure 6. Due to an absence of econometric estimates, we assume conservative elasticities taken from estimates in the literature on developing countries. Note that, although the assumed production elasticity of substitution found in the first three columns are the same for all sectors, their relative shares are different. Relative shares are more important in the sense that the simulation results are driven more by the structure of the economy rather than just the differences in the choice of elasticity parameters.

Similarly, the last two columns of table 4 show the elasticities for the CES-Armington function (substitution between imports and domestic sales) and the CET function which reflects substitution between exports and domestic sales. These values were taken from the GTAP database.

Table 3. Parameters for CGE model (based on 2000 Philippine SAM)

	Gross output	Value added	Labour-private capital	CES Armington	CET
Crops and livestock	0.5	0.4	0.4	2.3	2.3
Other agriculture	0.5	0.4	0.4	2.8	2.8
Food, beverage and tobacco processing	0.5	0.4	0.4	2.3	2.3
Mining	0.5	0.4	0.4	2.8	2.8
Paper and wood	0.5	0.4	0.4	2.1	2.1
Petrochemical	0.5	0.4	0.4	1.9	1.9
Textile and garment	0.5	0.4	0.4	2.3	2.3
Heavy manufacturing	0.5	0.4	0.4	2.8	2.8
Light manufacturing	0.5	0.4	0.4	3.0	3.0
Other manufacturing	0.5	0.4	0.4	2.8	2.8
Public services	0.5	0.4	0.4	1.9	1.9
Other services	0.5	0.4	0.4	2.6	2.6

SAM = Social accounting matrix.
Source: Authors' computations.

5.3 Microsimulation module

A top-down CGE microsimulation procedure is employed by using the results of the CGE simulations as inputs into a microsimulation module in order to assess the distributive impacts of higher public infrastructure investments. The microsimulation module, which is based on Cockburn, Duclos and Tiberti (2011), uses the 2006 Family Income and Expenditure Survey (FIES) of the Philippines.

For brevity, we only summarize the microsimulation procedure (for details see Cockburn Duclos and Tiberti, 2011). Initially, the FIES is processed to classify constrained and non-constrained households. A logit model specifies the probability of being a non-constrained household (Y_i=1; Y_i=0 if constrained), which is defined as: has access to formal credit institutions, has saved or has a savings account. The logit model shown in equation [1] estimates the probability that a given household *h* is non-constrained ($p_{h,nc}$). By implication, the complement of $p_{h,nc}$ gives the probability that a given household *h* is constrained ($p_{h,c}$).

$$Logit(\pi_h) = \alpha + \beta_v X_h + \varepsilon_h \qquad \text{with } \pi_h = E\left(Y_h \middle| X_h\right) \qquad \textbf{[1]}$$

where vector X_h includes the *V* community and household socio-economic characteristics of household *h*: household's region and urban/rural residence, whether the household head receives

a fixed payment from work activities, the occupational category the household head belongs to, the natural logarithms of real per capita household consumption, household size, household head's gender and age, as well as the educational level of the household head and the household head's age squared.

To observe changes in household consumption levels following variations in the prices of goods and household income, the nominal consumption for each good is converted into real terms. Using a Cobb-Douglas utility function (fixed budget share), real per capita consumption is:

$$e_{t,h} = \frac{y_{t,c,h}}{\Gamma^0_{t,c,h}} \quad \text{with} \quad \Gamma^0_{t,c,h} = \prod_{k=1}^{K} \left(\frac{p_{t,c,k}}{p_{0,C,k}} \right)^{w_{h,c,k}} \qquad \textbf{[2]}$$

where $y_{t,c,h}$ is the total nominal per capita expenditures of each household at time t; $\Gamma^0_{t,c,h}$ is the household-specific consumer price deflator which takes into account both spatial (by comparing cluster c to the reference cluster C) and temporal (by comparing time t to the reference time 0) price differences; $p_{0,C,k}$ is the reference unit price, which corresponds to the price of good k at time 0 (the reference period) and is selected in a given cluster C (the reference cluster, which is the capital region, NCR); $p_{t,c,k}$ is the unit price at time t for good k in cluster c; $w_{h,c,k}$ is the budget share for good k by household h in cluster c.

To be consistent with the household classifications in the CGE model, the micro-simulation procedure takes into account the differences in savings and consumption of all households, particularly non-constrained households which can change their savings rate over time (in contrast to constrained households whose savings rate is fixed). Per capita consumption for a household $y_{t,c,h}$ at time t is calculated as:

$$y_{h,t} = y_{h,t=0} + \sum_{k=1}^{j} \left(\Delta R^k_{h,t} p_{h,nc} (1 - s_{nc,t}) + \Delta R^k_{h,t} p_{h,c} (1 - s_c) \right) \qquad \textbf{[3]}$$

where $y_{t,c,h}$ is defined as the sum of per capita consumption of household h in the base year ($y_{h,t=0}$), following changes in the k revenue components (R), namely wage and non-wage incomes. As for non-wage revenues, those from self-employment activities and from agricultural own-production were considered. Changes in these sources are taken from the CGE simulation results and plugged into the micro module. As defined by equation [3], changes in the revenue sources are weighted by the probability of household h being non-constrained $p_{h,nc}$ (and the complementary situation of being constrained). Only the shares devoted to consumption are retained for consumption: ($1-s_{nc,t}$) for non-constrained households and ($1-s_c$) for constrained households, where $s_{nc,t}$ and s_c are the saving rates for the two types of households.

Poverty effects are measured using the Foster-Greer-Thorbecke (FGT) $P\alpha$ class of additively decomposable measures (Foster, Greer and Thorbecke, 1984). Poverty indices are calculated

before and after the policy shock using the actual distribution of income in the FIES. The FGT poverty measure is:

$$P_{\alpha} = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^{\alpha} \qquad \textbf{[4]}$$

where α is the poverty aversion parameter; n is population size; q is the number of people below the poverty line; y_i is income; and z is the poverty line.

The FGT poverty measure depends on the values that the parameter α takes. We calculate the poverty headcount for $\alpha = 0$. The poverty headcount is the proportion of the population that falls below the poverty line. When $\alpha = 1$, the poverty gap indicates how far the poor are from the poverty line on average. Finally, when $\alpha = 2$, the severity of poverty is measured as the squared average distance of income of the poor from the poverty line. The severity index is more sensitive to the distribution among the poor because the poorest of the poor in the population are weighted more heavily.

Inequality is calculated using the Gini coefficient, which is the most commonly used measure of inequality. It computes the average distance between cumulative population shares and cumulative income shares (Duclos and Araar, 2006). The Gini coefficient is calculated as:

$$Gini \equiv I(2) = \int_0^1 \left(p - L(p)\right)\kappa(p;2)dp \qquad \textbf{[5]}$$

where $L(p)$ is the cumulative percentage of total income held by the cumulative proportion p of the population (ranked by increasing income) and k represents the percentile-dependent weights.

6. POLICY EXPERIMENTS

Using the CGE model, we conduct two policy experiments to assess the potential effects of higher public investment expenditures financed by: (1) international financing with a concessional interest rate of 6 percent; or (2) higher production taxes. The policy focus of this paper leads us to stay within reasonable limits of attainable government policies, so we simulate a 25 percent permanent increase in the public infrastructure expenditure-to-GDP (PIE-GDP) ratio relative to the baseline. This increase is sufficient to achieve the government's minimum target of a 5 percent PIE-GDP ratio.

As mentioned in section 2, a contentious empirical issue is the estimation of the elasticity of output to public capital. Given the absence of econometric estimates, we assume a conservative exogenous elasticity of output to public capital of 0.15 percent—a lower-end estimate that is consistent with most empirical studies. This conservative value was chosen to account for concerns that large estimates on output elasticity of public capital could emanate from high public investment (as a proportion of GDP)—as corruption tends to inflate public investments, from

unproductive uses in public capital and from the composition of public capital. We nevertheless undertake sensitivity analysis in order to determine the sensitivity of the economic and poverty-related indicators to changes in the assumed elasticity of output to public capital.

Based on the SAM, exogenous annual population growth of 1.8 percent, a foreign concessional lending rate of 6 percent, a depreciation rate of 15 percent and our capital accumulation assumption, the dynamic model is calibrated and solved to reproduce the baseline path (Business as Usual, or BaU) over 50 years, which we then compare to the counterfactual simulation results. In the BaU, all real variables are expressed in efficiency units and all prices are constant.

7. SIMULATION RESULTS

To trace the economy-wide effects arising from higher public investment expenditures, we decompose the results into aggregate and sectoral effects over three time frames: the immediate period (first year), the short run (fifth year) and the long run (twentieth year). Since investments made in the current year will only become fully operational in the following year, we begin with a focus on the demand-side effects of an increase in the PIE-GDP ratio in the first year. Subsequently, the demand and supply effects are discussed for the immediate time frame and the long run. Note that all results are presented as percentage deviations from the economy's baseline trajectory. Presenting results this way allows us to isolate the economy-wide effects arising from higher public investment.

7.1 Scenario 1: 25 percent increase in PIE-GDP ratio (international financing)

Macro effects: The macroeconomic results of scenario 1—a 25 percent increase in the PIE-GDP ratio financed by international financing at concessional interest rates—are shown in the first three columns of table 4. Compared to scenario 2, the immediate consequence of higher public investments financed by international borrowing is stronger real exchange rate appreciation (1.6 percent), thereby improving the purchasing power of the Philippine economy.

Imports rise by 2.6 percent, as the real exchange rate appreciation induces more substitution—of both capital and consumer goods—from domestically produced goods to cheaper imported goods. This real exchange rate appreciation also leads to a significant reduction in exports (2.8 percent), which become relatively more expensive in the international market.

Total investment increases by 6.4 percent, which is 1.4 percentage points more than in scenario 2, as both public and private investments expand. Essentially, this difference is due to private investment, which rises by 0.8 percent in scenario 1 but falls by 0.6 percent in scenario 2. The main driver of this effect is international capital inflows which finance increased public investment expenditures. Hence, in the absence of higher production taxes, domestic firms enhance their profitability by producing more capital goods and by accumulating private capital stock.

The price of investment goods nevertheless rises by 1 percent—the highest in all periods in this scenario—because the productivity-enhancing effects of public investments are not realized until after the first year. Mindful that a rise in productivity arising from public investment will result in higher returns on investment in the future, non-constrained firms (with better ability to exercise foresight) increase their level of investment in the first year by less than constrained firms (0.5 percent vs. 1.4 percent).

Table 4. Macro-economic results (percent deviations from baseline)

	International financing			Production tax financing		
	First	Short run	Long run	First	Short run	Long run
Real GDP	-0.1	1.5	2.9	-0.2	0.9	2.0
Wage rate	1.0	3.6	6.5	-1.0	1.5	4.1
Price of investment good	1.0	0.6	0.2	0.4	0.2	0.0
Total investment	6.4	7.7	8.2	5.2	6.6	7.1
Public investment	25.6	27.1	28.7	25.2	26.5	27.8
Private investment	0.8	2.0	2.3	-0.6	0.9	1.2
Constrained	1.4	1.7	1.9	-0.5	-0.2	0.1
Non-constrained	0.5	2.3	2.5	-0.6	1.5	1.8
Total household consumption	2.2	2.5	2.7	0.2	0.4	0.6
Constrained	2.4	2.3	2.0	-0.1	0.0	0.1
Non-constrained	1.9	2.7	3.3	0.6	0.8	1.1
Total exports	-2.8	-0.7	2.0	-1.2	1.0	3.5
Total imports	2.6	3.0	3.5	1.0	1.9	2.5
Real exchange rate*	-1.6	-0.9	-0.5	-0.6	-0.5	-0.4
Foreign saving	0.9	0.4	-0.3	0.8	0.4	-0.2
Total capital stock*	0.0	3.8	8.2	0.0	3.3	7.2
Public capital stock*	0.0	13.5	27.5	0.0	13.3	26.6
Private capital stock*	0.0	0.7	2.1	0.0	0.1	1.0
Constrained*	0.0	0.8	1.8	0.0	-0.2	0.1
Non-constrained*	0.0	0.7	2.3	0.0	0.3	1.6
Disposable income of constrained households	2.4	2.3	2.0	-0.1	0.0	0.1
Labour income	1.0	3.6	6.5	-1.0	1.5	4.1
Capital income	2.7	4.3	5.3	-0.1	2.0	3.5
Government revenue	8.4	9.6	10.9	6.9	8.3	9.6
Increase in production tax rate (%)	-	-	-	27.0	24.9	22.4
Additional international borrowing (% of GDP)	1.1	1.1	0.9	-	-	-

Source: Authors' computation based on simulation results
*A positive sign indicates a depreciation of the real exchange rate.

Total household consumption increases by 2.2 percent, which is 2 percentage points more than in scenario 2, as consumption of both constrained and non-constrained households respectively rise by 2.4 percent and 1.9 percent. Two factors are behind this change. First, the additional real exchange rate appreciation makes imported goods relatively cheaper, thereby inducing higher consumption. Second, higher income arising from the rise in returns to labour and

capital stimulates household consumption. The result of all these demand-side changes is a smaller fall in real GDP (0.1 percent) relative to scenario 2. Real GDP falls, as the increase in public investment expenditures was not high enough to outweigh the stronger demand for imported goods and significantly lower exports.

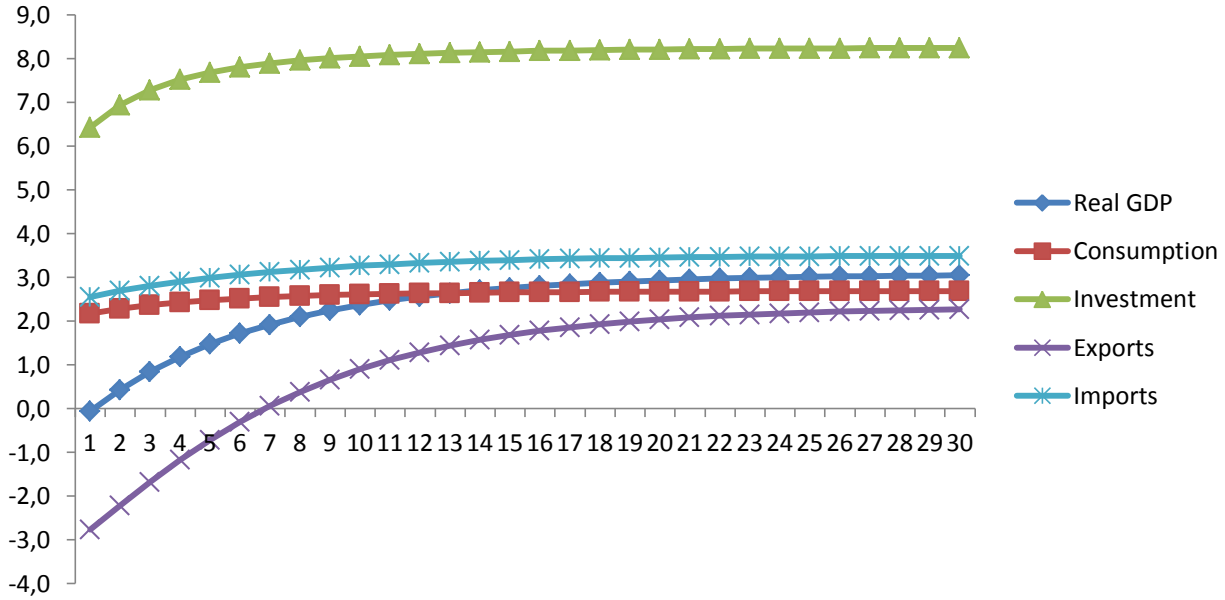
The positive economic effects strengthen in the short run and long run as a result of ongoing capital accumulation and improved productivity. A comparison of capital stock accumulation reveals that the stock of private capital grows by more in this scenario than in the tax financing scenario. Indeed, the total stock of private capital expands by 0.7 percent and 2.1 percent, respectively in the short run and long run in this scenario, as compared to 0.1 percent and 1 percent in scenario 2.

The disposable income of constrained households rises more in the short and long run, respectively by 2.3 and 2 percent. This is largely due to the increase in these households' labour income (by 3.6 percent in the short run and 6.5 percent in the long run) and their capital income (by 4.3 percent in the short run and 5.3 percent in the long run). Higher incomes in turn lead to higher total household consumption, which grows by 2.5 percent and 2.7 percent over the short run and long run.

Investments made by constrained households rise by 2 percent in the short run and by 2.3 percent in the long run, while investments by non-constrained firms increase by 3.8 percent and 8.2 percent over these time frames. Similarly, total investment in the short and long run grows by more in this scenario (7.7 percent and 8.2 percent), as higher public investment is complemented by a rise in private investment.

Over time, the stronger real exchange rate appreciation resulting from the continuous inflow of international financing results in slower export growth and accelerated import growth (figure 4). Although exports eventually recover due to the productivity-enhancing effects of additional public infrastructure, long-run potential export growth is somewhat lower than the baseline. This is the primary driver behind a deteriorating trade balance over time, exactly opposite to the situation observed in scenario 2. Nevertheless, public infrastructure investments still exhibit stronger positive economic effects over time, as reflected by a higher level of real GDP in the both the short run (1.5 percent) and long run (2.9 percent).

Figure 4. GDP: Demand side effects (international financing)



Source: Authors' computation based on simulation results

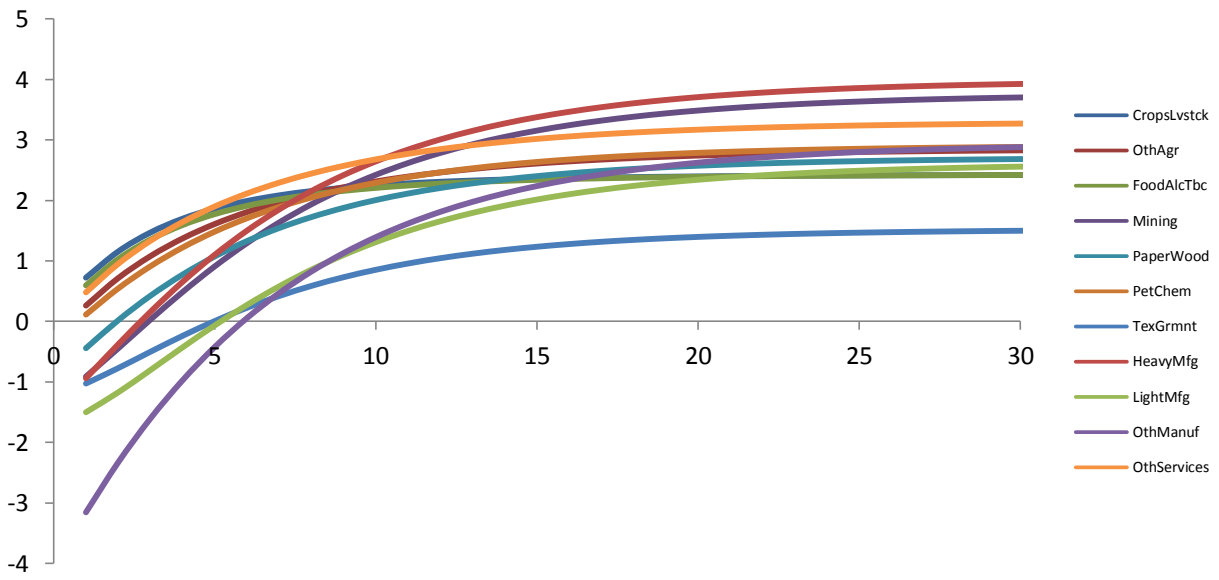
Sectoral effects: We now analyze the sectoral effects of a 25 percent rise in the PIE-GDP ratio through international financing (table 5). Exports are much lower in every sector (between 1.1 and 6.4 percent) because the strong real exchange rate appreciation causes them to lose their competitiveness in the international market. Similarly, imports increase substantially in every sector, by between 0.3 and 5.1 percent, because domestic consumers substitute domestic goods for cheaper imported products. The real exchange rate appreciation, together with stronger demand for capital goods, boost imports in the light manufacturing, heavy manufacturing and construction services sectors since these sectors provide inputs for (increased) public investment.

In contrast to scenario 2, output expands in the crops/livestock, other agriculture, food processing, petrochemical and other services sectors (0.7, 0.3, 0.6, 0.1 and 0.5 percent respectively) in the absence of a distortionary production tax. Unfortunately this is not the case for the textiles, light manufacturing, heavy manufacturing and other manufacturing sectors, which are held back by the real exchange rate effect, an effect which has essentially the same impact on the market as a production tax. Indeed, the additional real exchange rate appreciation makes imported capital goods (light and heavy manufacturing) relatively cheaper, causing domestic producers of these products to lose their competitiveness in the first year. Total demand for goods and services from all sectors rises substantially more than in scenario 2. This is because of the stronger demand for cheaper imports and the effect of producers shifting towards the domestic market following exchange rate appreciation. This trend persists in both the short and long run.

The long-run supply-side effects of higher public investment resulting from capital accumulation and improved productivity are felt by producers across the entire economy (figure 5). The beneficial impacts on long-run output are felt much more evenly across sectors of the economy

than in scenario 2, with domestic producers posting an average growth of at least 2.3 percent; the smallest improvement is seen in the textiles sector, at 1.4 percent.

Figure 5. Effects on output, by sector (international financing)

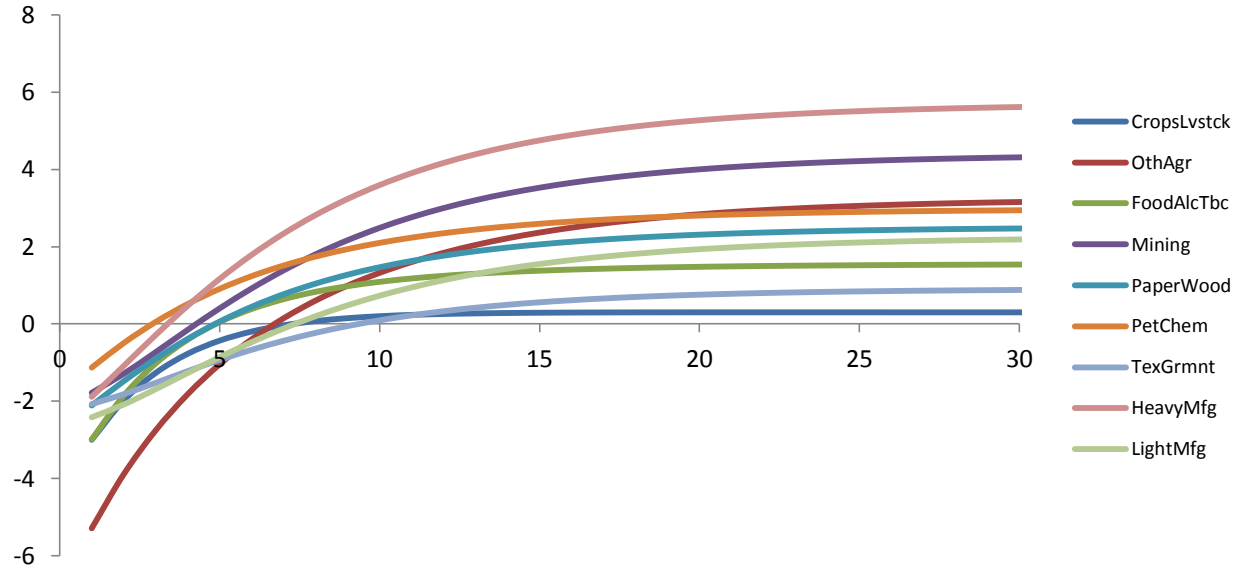


Source: Authors' computation based on simulation results

The positive spillover effects increase the competitiveness of domestic producers in the international market, supporting export recovery (figure 6). This contrasts with scenario 2, where both food processing and petrochemical exports do not recover, even in the long run. Nonetheless, imports (figure 7) continue to outpace exports in the long run due to the persistently higher real exchange rate.

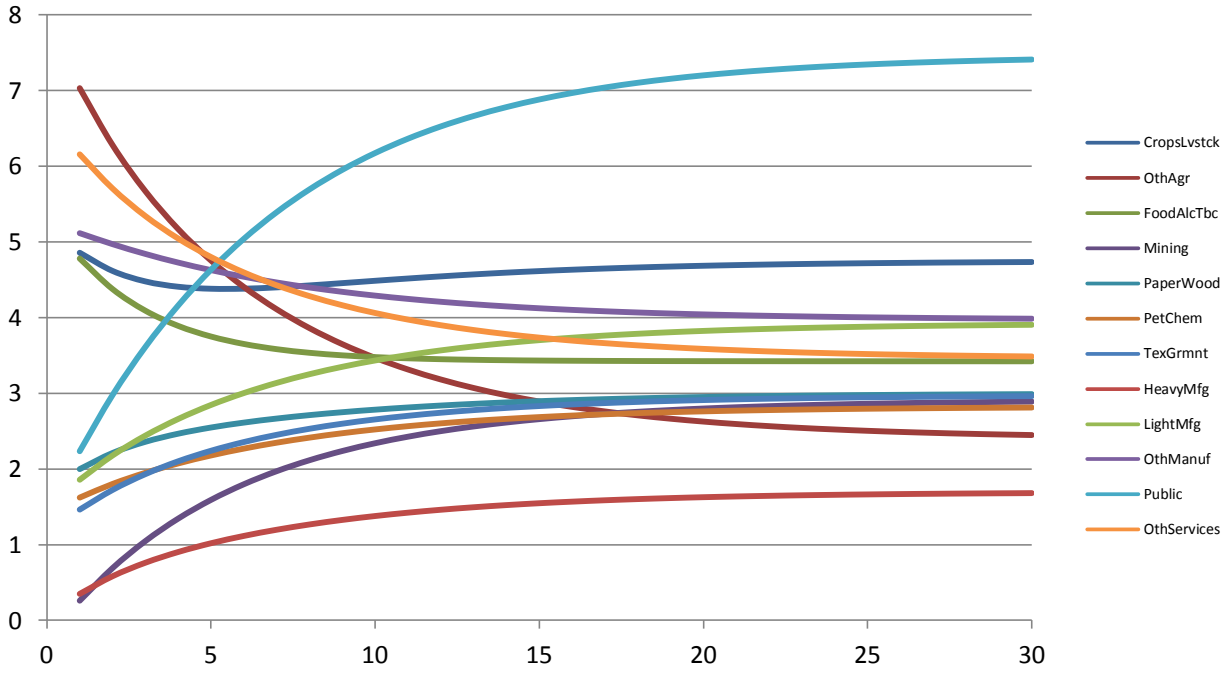
The long-run demand-side effects are similar to scenario 2, with all sectors experiencing an increase in investment over time. Being an important producer of capital goods, heavy manufacturing registers an important expansion of investment in both the short run (1.4 percent) and long run (2.6 percent), resulting in substantial output and export growth over these time frames. In summary, public investment financed by international financing at a concessional rate benefits all sectors almost equally in terms of output expansion in the long run. The reallocation of factors from the agricultural sector towards the heavy and light manufacturing sectors that was observed in scenario 2 does not occur in scenario 1.

Figure 6. Effect on exports, by sector (international financing)



Source: Authors' computation based on simulation results

Figure 7. Effect on imports, by sector (international financing)



Source: Authors' computation based on simulation results

Table 5. Sectoral effects (Scenario 1: International financing, percent deviations from baseline)

	Crops, livestock	Other agriculture*	Food processing	Mining	Paper, wood	Petro-chemical	Textiles, garments	Heavy manufacturing	Light manufact.	Other manufact.*	Public services	Other services*
Gross output												
First	0.7	0.3	0.6	-0.9	-0.4	0.1	-1.0	-0.9	-1.5	-3.2	0.0	0.5
Short-run	1.9	1.6	1.8	0.9	1.1	1.5	0.0	1.1	-0.1	-0.4	0.0	1.9
Long-run	2.4	2.7	2.4	3.5	2.6	2.8	1.4	3.7	2.3	2.6	0.0	3.2
Employment												
First	1.0	0.7	0.8	-1.1	-0.5	-0.1	-1.2	-1.1	-1.7	-3.1	0.1	0.8
Short-run	0.8	0.5	0.6	-0.4	-0.2	0.2	-1.2	-0.3	-1.4	-1.6	-0.6	0.8
Long-run	0.2	0.2	0.0	0.8	0.1	0.2	-1.0	1.0	-0.2	0.1	-1.2	0.6
Investment (sector of destination)**												
First	3.4	0	3.0	-0.7	0.4	1.3	-2.0	-0.5	-2.7	0	0.4	0
Short-run	2.9	0	2.7	2.6	2.3	2.6	0.9	2.8	1.4	0	1.1	0
Long-run	2.7	0	2.6	3.6	2.7	2.8	1.6	3.7	2.6	0	1.3	0
Exports												
First	-3.0	-5.3	-3.0	-1.8	-2.1	-1.1	-2.1	-1.9	-2.4	-6.4	-2.2	-4.2
Short-run	-0.4	-1.0	0.0	0.4	0.1	0.9	-0.9	1.2	-0.9	-2.3	-4.4	-0.6
Long-run	0.3	2.8	1.5	4.0	2.3	2.8	0.8	5.3	1.9	2.0	-6.7	2.8
Domestic sales												
First	0.9	0.7	0.8	-0.8	-0.1	0.2	-0.3	-0.8	-0.3	-1.3	0.0	0.8
Short-run	1.9	1.8	1.9	1.0	1.3	1.5	0.6	1.1	1.0	0.7	0.0	2.1
Long-run	2.5	2.7	2.4	3.4	2.6	2.8	1.8	3.4	2.9	3.0	0.0	3.2
Imports												
First	4.9	7.0	4.8	0.3	2.0	1.6	1.5	0.3	1.9	5.1	2.2	6.2
Short-run	4.4	4.8	3.7	1.6	2.5	2.2	2.2	1.0	2.8	4.6	4.6	4.8
Long-run	4.7	2.6	3.4	2.8	2.9	2.8	2.9	1.6	3.8	4.0	7.2	3.6
Domestic demand												
First	1.1	0.7	1.1	0.1	0.3	0.6	0.2	-0.5	0.9	1.5	0.0	1.3
Short-run	2.1	1.8	2.0	1.5	1.5	1.7	1.1	1.1	2.0	2.5	0.0	2.3
Long-run	2.6	2.7	2.5	2.9	2.7	2.8	2.2	2.9	3.4	3.4	0.0	3.2
Consumption												
First	1.3	0.9	1.4	2.6	2.0	2.2	2.2	2.4	2.4	1.6	1.7	1.2
Short-run	1.9	1.9	2.1	2.7	2.3	2.5	2.3	2.7	2.5	2.1	0.8	2.0
Long-run	2.0	2.8	2.4	2.8	2.6	2.7	2.5	3.1	2.6	2.6	-0.2	2.6

Source: Authors' computation based on simulation results; *Constrained industries: Investment from constrained firms, by sector.

7.2 Scenario 2: 25 percent increase in PIE-GDP ratio (production tax financing)

Macro effects: The macro-economic results of scenario 2—a 25 percent increase in the PIE-GDP ratio financed by higher production taxes—are shown in the last three columns of table 4. Total investment in the first year is 5.2 percent higher, mainly due to the 25 percent growth in public investment. A slight reduction in private investment (0.6 percent) results from a crowding-out effect. This crowding-out effect is caused by higher prices of investment goods (+0.4 percent) and the higher production tax rate imposed on firms in order to balance the government budget. Total private investment thus falls: non-constrained firms with better ability to exercise foresight decrease their level of investment by marginally more (-0.6 percent) than constrained firms (-0.5 percent).

Imports rise by 1.0 percent as higher public investments boost demand for imported capital goods and as the local economy substitutes away from the now more expensive domestically produced goods. Exports fall by 1.2 percent because domestic firms are less competitive on international markets due to the higher cost structures associated with higher production taxes. The combination of lower exports and higher imports results in a real exchange rate appreciation of 0.6 percent and a deterioration in the trade balance.

Real GDP is 0.2 percent lower than the baseline in the first year. Although increased public investments generally lead to increased output, this effect is not strong enough to offset surging demand for imported goods and falling exports. The positive supply-side effects of higher public investment expenditures take time, as the effects of higher capital accumulation and improved productivity set in.

The rate of taxation on production rises by 27 percent[10]—relative to the baseline—to finance the 25 percent increase in public investment expenditure. The higher taxes impose an additional burden on firms in the economy, reducing their capacity to pay wages and returns to capital (-1.0 and -0.1 percent respectively) to factor owners. Indeed, lower factor returns cause disposable income and consumption to fall marginally (-0.1 percent) among constrained households; the consumption of non-constrained households rises by 0.6 percent because they cause their savings to smooth consumption.

The public capital stock increases substantially relative to the baseline situation in both the short run (13.3 percent in 5 years) and long run (26.6 percent in 20 years), while the private capital

[10] Note: this figure represents the uniform percentage change in the effective production tax rates, and are not necessarily identical across industries. It is also worth mentioning that this increase is not as large as it may seem given that initial production tax ranges from 0.7 percent in paper and wood to 9 percent in petrochemical sector. The largest new production tax rate is, for example, 11.4 percent.

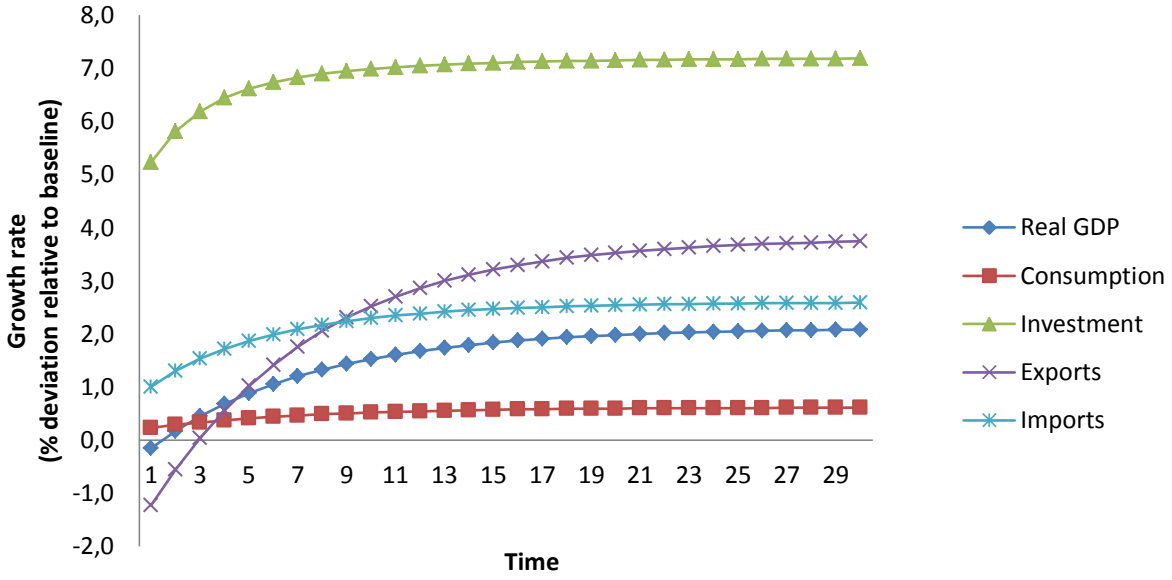
stock only grows by 0.1 percent and 1 percent over this time frame relative to scenario 1. The disposable income of constrained households rises, particularly in the long run. This results from increased wage and capital income, which respectively rise by 1.5 percent and 2 percent in the short run, and by 4.1 percent and 3.5 percent in the long run. It is worth noting that the beneficial effects that a higher stock of public capital and higher productivity have on wages allow the government to collect more income taxes from households. Hence, the rise is production tax rate is dampened in the short and long run as higher income taxes and public capital stock helped finance the increase in public expenditures. Higher productivity likewise mitigates the increase in the price of investment goods in the long run, effectively incentivizing private sector investment.

We will now address the demand-side effects over time, as seen in figure 8. Higher public investment bolsters the total stock of capital in the economy, stoking private investment in both the short run (6.6 percent) and the long run (7.1 percent). This phenomenon of rising public and private investment over time appears to suggest that public infrastructure investments complement private sector investments, i.e., that a crowding-*in* effect also takes place in both the short run and long run. Since profitability is higher under improved productivity, both constrained and non-constrained firms attract more private investment in the long run. Non-constrained firms increase their level of investment by more than constrained firms because they anticipate future changes in capital productivity, whereas constrained firms increase their investment to a lesser extent due to the constrained expectations of their owners (constrained households).

Higher productivity helps reduce the burden of higher production taxes and supports improved competitiveness of domestic firms in the international market. This stimulates exports growth, which eventually outpaces import growth in the long run. The additional real exchange rate appreciation observed in the first year tapers off in the short and long run. Moreover, the higher export growth helps improve the balance of trade. Total short- and long-run consumption respectively grow by 0.4 percent and 0.6 percent, as consumption of both constrained and non-constrained households rises with income.

The net effect of these changes is a relative increase in real GDP, by 0.9 percent in the short run and 2 percent in the long run. This confirms that additional public infrastructure investments positively affect the economy of the Philippines through productivity and capital accumulation effects that begin to take hold in the short run.

Figure 8. GDP: Demand-side effects (production tax financing)

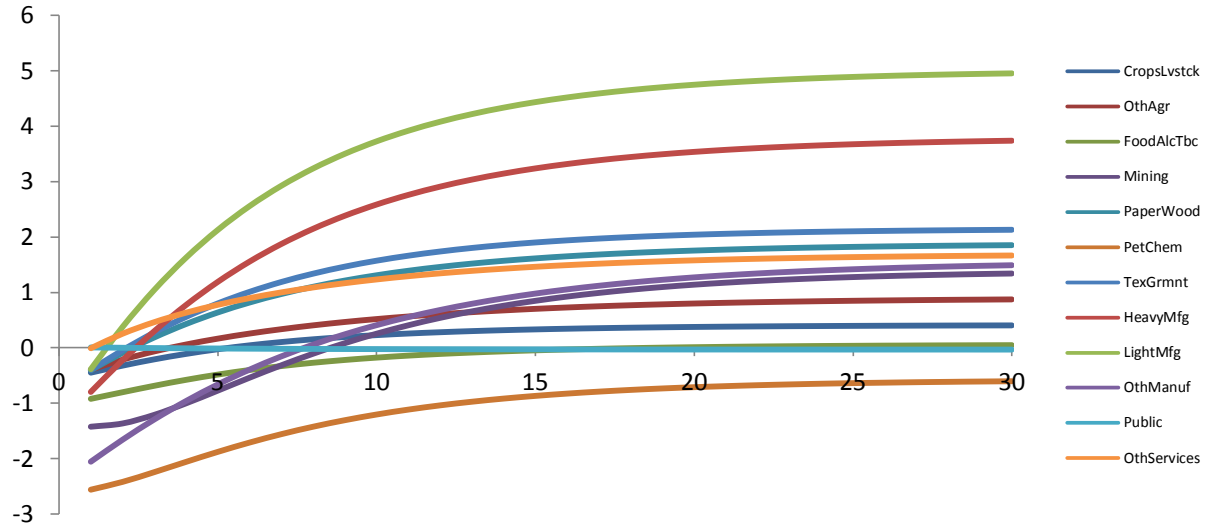


Source: Authors' computation based on simulation results

Sectoral effects: In contrast to scenario 1, the direct consequence of using a higher production tax to finance public investments in capital infrastructure is a higher cost structure among firms, causing a contraction in output in every producing sector in the economy (table 6). Exports fall significantly (between 0.3 and 3.3 percent in the first year) as domestic firms lose their competitiveness in the international market. Moreover, the higher domestic cost structure together with increased demand for investment goods leads to a fairly substantial increase in imports, particularly in the light manufacturing (1.4 percent), heavy manufacturing (1.7 percent) and other services (1.9 percent) sectors. The food/beverage/tobacco sector likewise registers a 1.8 percent rise in imports since the domestic economy tends to substitute towards cheaper imported processed food from similar domestically produced goods.

In the first year, total domestic demand falls in most sectors, with the exceptions of the light manufacturing, heavy manufacturing and other services sectors, which are more heavily used in public investment. Domestic demand improves in all sectors in the short and long run, particularly in the light manufacturing, heavy manufacturing and other services sectors (figure 9). In the long run, the positive supply-side effects of higher public investment (capital accumulation and improved productivity) benefit all producers in the economy. This is particularly true in the long run in the light and heavy manufacturing, textiles and other services sectors, which register significant additional output growth in the long run. Although relatively modest, many other sectors experience the same output expansion effect (crops and livestock, other agriculture, food/alcohol/tobacco). Imports increase in the food processing and petrochemical sectors, so we observe an associated decline in output in this scenario.

Figure 9. Effects on sectoral output (production tax financing)



Source: Authors' computation based on simulation results.

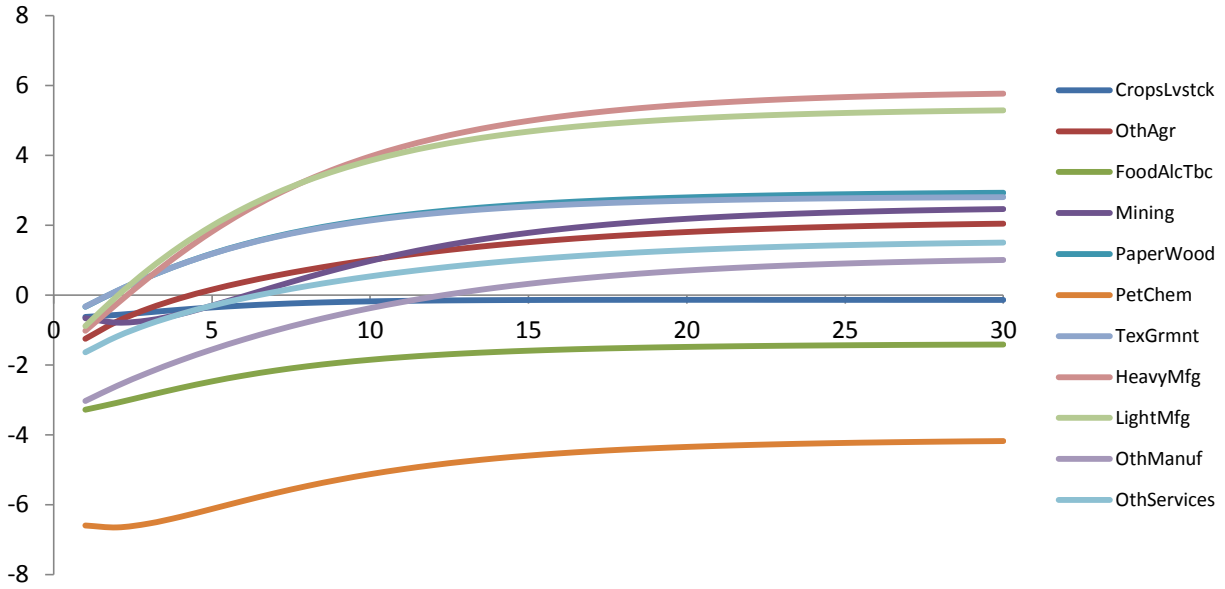
The positive spillover effects likewise improve the competitiveness of domestic producers in the international market. Indeed, exports recover in both the short and long run in nearly every sector (figure 10), eventually to outpace relative growth in sectoral imports (figure 11). Food processing and petrochemicals are exceptions in this regard because the Philippines is a net importer of food and oil. Export growth is concentrated in manufacturing sectors (particularly textiles, light manufacturing and heavy manufacturing) which were already export-oriented. Import growth outpaces export growth in the agriculture and food/beverage/tobacco sectors throughout the scenario, reflecting the Philippine economy's general dependence on imports in these sectors.

All sectors experience an increase in investment over time (table 6). As a major producer of capital goods, heavy manufacturing registers the greatest expansion in investment (2.3 percent in the first period and 4.9 percent in the long run). This strong investment growth also explains the significant short- and long-run output and export growth in the heavy manufacturing sector, since it directly benefits from the positive supply-side effects of higher public investment. The shadow price of capital immediately rises, and continues to do so in the short run because the increase in public investment crowds out private investment. This price eventually falls in the long run due to the productivity-enhancing effects of increased public spending on infrastructure.

In summary, the sectoral effects suggest that the productivity-enhancing effects of higher public investment strengthen over time, with the manufacturing and services sectors benefiting relatively more than the agricultural sector in terms of greater output (figure 9) and exports (figure 10). Compared to scenario 1, the net impact of the tax financing scenario is a reallocation of factors,

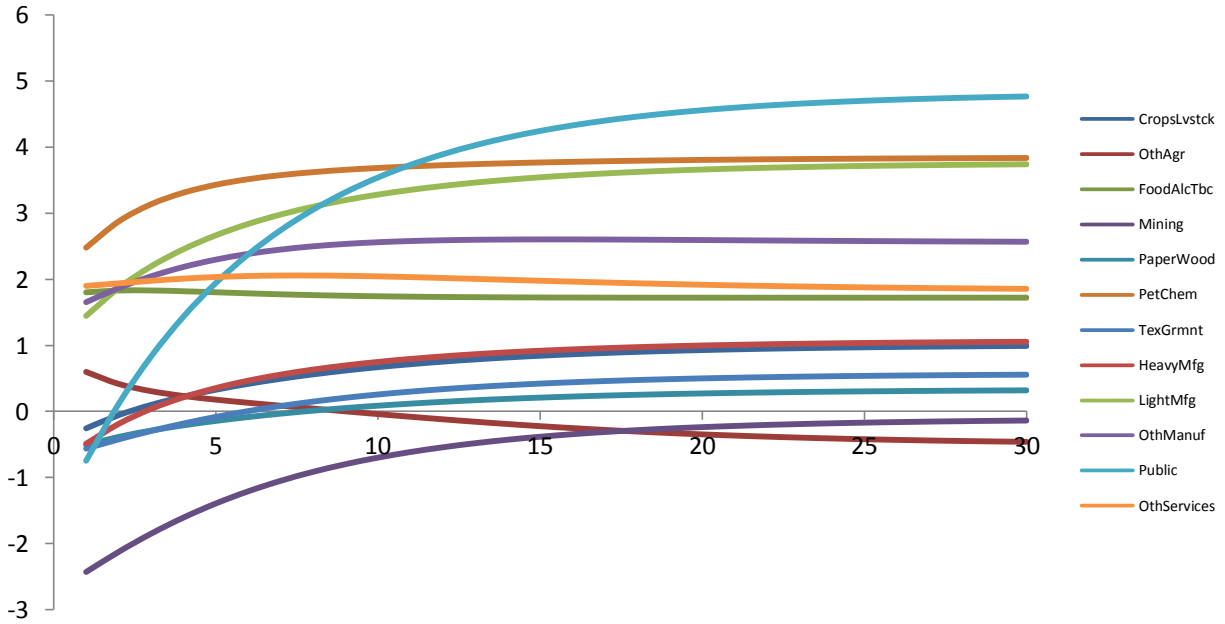
particularly of labour, from the agricultural sector towards the light manufacturing and heavy manufacturing sectors.

Figure 10. Effects on exports, by sector (production tax financing)



Source: Authors' computation based on simulation results

Figure 11. Effect on imports, by sector (production tax financing)



Source: Authors' computation based on simulation results

Table 6. Sectoral effects (Scenario 2: Production tax financing, percent deviations from baseline)

	Crops, livestock	Other agriculture*	Food processing	Mining	Paper, wood	Petro-chemical	Textiles, garments	Heavy manufact.	Light manufact.	Other manufact.*	Public services	Other services*
Gross output												
First	-0.4	-0.4	-0.9	-1.4	-0.4	-2.6	-0.4	-0.8	-0.4	-2.1	0.0	0.0
Short-run	0.0	0.2	-0.5	-0.8	0.6	-1.9	0.8	1.2	2.1	-0.7	0.0	0.8
Long-run	0.4	0.8	0.0	1.1	1.8	-0.7	2.0	3.5	4.7	1.3	0.0	1.6
Employment												
First	-0.2	0.0	-0.4	-1.4	0.0	-2.1	0.0	-0.4	0.1	-1.6	0.3	0.5
Short-run	-0.8	-0.6	-1.0	-1.7	0.0	-2.4	0.2	0.5	1.5	-1.2	-0.2	0.2
Long-run	-1.4	-1.1	-1.6	-0.9	-0.1	-2.3	0.3	1.6	3.0	-0.4	-0.8	-0.2
Investment (sector of destination)												
First	-1.4	0.0	-1.9	-4.0	-0.1	-5.6	0.2	0.3	2.3	0.0	-0.1	0.0
Short-run	0.0	0.0	-0.2	-0.3	1.3	-1.4	1.7	2.8	4.3	0.0	0.7	0.0
Long-run	0.3	0.0	0.1	1.0	1.7	-0.6	2.0	3.5	4.9	0.0	0.8	0.0
Exports												
First	-0.6	-1.3	-3.3	-0.7	-0.3	-6.6	-0.3	-1.0	-0.9	-3.0	0.8	-1.6
Short-run	-0.4	0.2	-2.5	-0.3	1.2	-6.1	1.2	1.8	2.0	-1.6	-1.9	-0.3
Long-run	-0.1	1.8	-1.5	2.2	2.8	-4.3	2.7	5.5	5.0	0.7	-4.4	1.3
Domestic sales												
First	-0.4	-0.3	-0.8	-1.5	-0.4	-2.2	-0.4	-0.8	0.3	-1.5	0.0	0.1
Short-run	0.0	0.2	-0.4	-0.8	0.5	-1.5	0.5	1.1	2.3	-0.1	0.0	0.9
Long-run	0.4	0.7	0.1	1.0	1.5	-0.4	1.6	3.2	4.4	1.6	0.0	1.6
Imports												
First	-0.3	0.6	1.8	-2.4	-0.5	2.5	-0.6	-0.5	1.4	1.7	-0.7	1.9
Short-run	0.3	0.2	1.8	-1.4	-0.1	3.4	-0.1	0.4	2.7	2.3	1.9	2.0
Long-run	0.9	-0.3	1.7	-0.2	0.3	3.8	0.5	1.0	3.7	2.6	4.6	1.9
Domestic demand												
First	-0.4	-0.3	-0.6	-2.3	-0.4	-1.0	-0.5	-0.7	0.9	0.6	0.0	0.3
Short-run	0.0	0.2	-0.2	-1.3	0.4	-0.2	0.4	0.9	2.5	1.3	0.0	1.0
Long-run	0.4	0.7	0.2	0.0	1.3	0.7	1.3	2.6	4.0	2.0	0.0	1.6
Consumption												
First	0.4	0.2	-0.4	0.5	0.5	-1.0	0.5	0.4	0.3	0.1	0.8	-0.1
Short-run	0.4	0.6	-0.1	0.6	0.8	-0.9	0.7	0.7	0.5	0.3	-0.3	0.2
Long-run	0.5	1.0	0.1	0.7	1.0	-0.6	0.9	1.1	0.7	0.5	-1.2	0.6

Source: Authors' computation based on simulation results; *Constrained industries: Investment from constrained firms, by sector.

7.3 Poverty and inequality effects

We now analyze the distributional effects of higher public investments in the Philippines. As shown in table 7, the changes in the poverty headcount and Gini inequality coefficient are similar, although the magnitude of the results is greater under the international financing scenario. The poverty headcounts under the foreign and tax financing scenarios respectively rise by 0.74 and 0.62 percentage points in the first year, but fall in the short and long run (respectively -0.63 and -1.64 under foreign financing and -0.21 and -1.07 under tax financing).

Table 7. Poverty and inequality effects (percentage points from baseline)

	International financing			Tax financing		
	First period	Short run	Long run	First period	Short run	Long run
Poverty headcount						
Base (national)	29.0					
Simulation	0.74*	-0.63*	-1.64*	0.62*	-0.21*	-1.07*
Components of changes in poverty headcount**						
Growth	0.65	-0.63	-1.73	0.63	-0.24	-1.08
Redistribution	0.09	0.00	0.08	-0.01	0.03	0.02
Change (in % points) in poverty headcount due to change in:						
Wage	-0.18	-0.72	-1.22	0.20	-0.25	-0.83
Self-employment	0.05	-0.39	-0.64	0.16	-0.17	-0.46
Own-consumption	0.00	0.00	0.00	0.00	0.00	0.00
Consumer prices	0.90	0.50	0.23	0.30	0.24	0.14
Poverty headcount (by location)						
Urban	0.38	-0.61	-1.43	0.36	-0.23	-0.95
Rural	1.09	-0.65	-1.86	0.87	-0.20	-1.17
Poverty headcount (by household type)						
Constrained	0.77	-0.55	-1.42	0.55	-0.24	-0.83
Non-constrained	0.73	-0.64	-1.68	0.63	-0.21	-1.10
Gini coefficient						
Base (national)	0.42					
Simulation (change in % points)	0.036	-0.013	-0.004	0.016	-0.003	-0.006

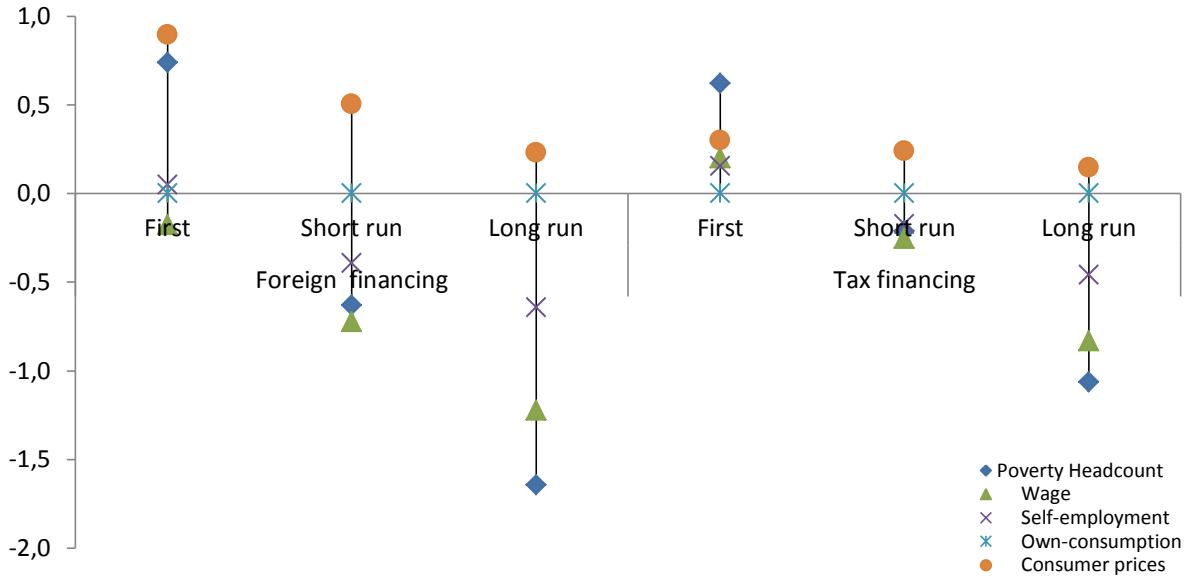
Source: Authors' calculation based on simulation results
Note: Base poverty headcounts are 14.2 (urban), 43.4 (rural), 45.4 (constrained) and 26.7 (non-constrained). The sum of the changes by source does not correspond precisely to the total change as people falling into poverty are not necessarily the same across the different channels.
*The difference (relative to the base year) is statistically different at the 1% level.
**Decomposition based on Shapley value (see Araar and Duclos 2009 for details on using *dfgtgr* command in DASP).

These changes in poverty and inequality essentially result from changes in household income and consumer prices. Indeed, a decomposition of the factors behind changes in the poverty headcount into income and price components (table 7) reveals that, during the first year and under the tax financing scenario, higher consumer prices and lower income (wages and self-employment) both lead to a higher incidence of poverty. In the foreign financing scenario, however,

higher wages limit poverty in the first year, but not by enough to offset the impact of higher consumer prices, resulting in a higher incidence of poverty.

The poverty headcount falls in both the short and long run. This occurs because the positive supply-side effects of increased public investment accrue over time, leading to higher wages and returns to capital (figure 12). Higher factor returns in the short and long run enhance the poverty-reducing effect of income, offsetting the poverty-increasing effect of higher consumer prices. Regardless of the scenario, it is the combined contribution of wage and self-employment income that allows the poverty headcount to fall in the medium and long run, although rising wage income is the dominant factor in this regard.

Figure 12. Contribution to changes in poverty headcount (scenarios 1 and 2, percentage points from baseline)



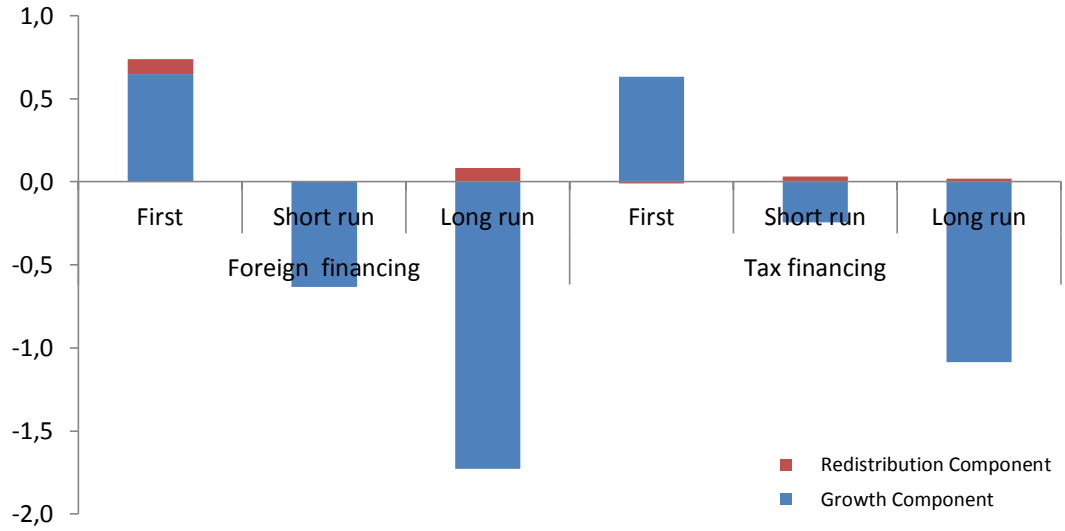
Source: Authors' calculation based on simulation results

Table 7 also shows the changes in the poverty headcount by location (urban and rural) and household type (constrained and non-constrained). Households in rural areas are more sensitive to the productivity-enhancing effects of public investment, as reflected by higher short- and long-term reductions in poverty headcounts than their urban counterparts. Similarly, higher returns to factor income drive stronger declines in the poverty headcount among non-constrained households than among constrained households, especially in the long run.

Finally, a decomposition of the factors behind changes in poverty headcounts, into growth and redistribution components (figure 13), reveals that, in the long run, the growth and redistribution components both reduce poverty in the tax financing scenario, whereas only the growth component reduces poverty in the international financing scenario. These results explain why the

(marginal) reduction in the Gini inequality coefficient is larger under the tax financing scenario than in the international financing scenario.

Figure 13. Growth and redistribution components
(changes in poverty headcount, percentage points)



Source: Authors' calculation based on simulation results

7.4 Sensitivity analyses

In addition to the two policy scenarios analyzed above, we also used the model to simulate alternative assumptions regarding the value of the elasticity of output to public capital. We test the sensitivity of the results to our assumed value for the elasticity of output to public capital (0.15) by recalculating our findings with elasticities of 0.1 and 0.2.

We present these alternative results in table 8 for selected macroeconomic indicators, the poverty headcount and the Gini coefficient. For the sake of comparison, we present these selected statistics under the original assumption that the elasticity of output to public capital is 0.15. The general trend observed here is that the magnitude of the results increases with the elasticity of output to public capital. We find that real GDP is at least 0.01 percentage points higher in the first year and is no less than 1 percentage point higher in the long run; the long term impact rises with the elasticity of output to public capital.

Table 8. Sensitivity of results to changes in elasticity of output to public capital

	Foreign financing						Tax financing					
	Elasticity of output to public capital											
	0.1		0.15		0.2		0.1		0.15		0.2	
	1st yr	LR	1st yr	LR	1st yr	LR	1st yr	LR	1st yr	LR	1st yr	LR
Aggregate results												
Real GDP	0.0	2.0	-0.1	2.9	-0.1	3.9	-0.1	1.0	-0.2	2.0	-0.2	3.0
Wage rate	0.7	4.3	1.0	6.5	1.4	8.9	-1.1	2.1	-1.0	4.1	-0.8	6.4
Total investment	6.1	7.4	6.4	8.2	6.8	9.1	5.0	6.3	5.2	7.1	5.5	8.1
Total consumption	1.5	1.9	2.2	2.7	2.8	3.5	1.5	2.3	1.5	2.3	1.5	2.3
Total exports	-2.2	0.9	-2.8	2.0	-3.3	3.3	-0.7	2.5	-1.2	3.5	-1.8	4.6
Total imports	2.1	2.7	2.6	3.5	3.0	4.3	0.7	1.9	1.0	2.5	1.4	3.3
Real exchange rate	-1.2	-0.4	-1.6	-0.5	-1.9	-0.5	-0.3	-0.4	-0.6	-0.4	-0.9	-0.4
Government revenue	8.1	9.7	8.4	10.9	8.8	12.2	6.6	8.4	6.9	9.6	7.2	10.8
Additional Production tax rate (%)	-	-	-	-	-	-	25.8	22.9	27.0	22.4	28.2	21.8
Additional foreign grant (% of GDP)	1.1	1.0	1.1	0.9	1.2	0.9	-	-	-	-	-	-
Poverty and inequality												
Poverty headcount	0.2	-1.2	0.7	-1.6	0.9	-2.6	0.5	-0.4	0.6	-1.1	0.7	-1.8
Gini coefficient	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0

LR = long run.
Source: Authors' calculation based on simulation results

The results follow the same general trend in terms of changes in poverty and inequality, both in the first year and in the long run. Indeed, the change in the poverty incidence increases as the elasticity of output to public capital increases from 0.1 to 0.2. Note that the long-run impact on inequality is slightly lower when testing values of 0.15 and 0.2 for the elasticity of output to public capital. The sensitivity analyses does, however, confirm that the effects of higher public investment on the economy and on poverty in the Philippines are quantitatively robust to differing assumptions in relation to the elasticity of output to public capital.

8. SUMMARY AND INSIGHTS

In the Philippines, public expenditures on physical infrastructure (particularly transportation and utility infrastructures) and the level of public educational spending are both comparatively low. The current government has embarked on policies that aim to further promote robust economic growth and eradicate poverty, in line with commitments to meet its MDGs. One of the policies being pushed primarily concerns infrastructure. This paper contributes to the policy debate on the role of public infrastructure in economic growth and poverty reduction in the Philippines. Our preliminary

results reveal that the positive supply-side effects of higher public investment expenditure manifest over time through higher capital accumulation and related improvements in productivity.

In conclusion, the simulation results suggest that a higher public infrastructure investment-to-GDP ratio not only brings about positive real GDP effects, but also reduces poverty and inequality in the short and long run. The simulation results follow a generally similar pattern, although the magnitude of the results is greater under the international financing scenario; this is due to the absence of higher production taxes that slightly hinder the competitiveness of domestic producers. For instance, public infrastructure spending financed by international borrowing at concessional rates of 6 percent caused output to expand in all sectors in the long run, whereas output does not expand in all sectors in the production tax financing scenario. Moreover, the decline in poverty is greater in both the short and long run when increased public infrastructure spending is financed through international borrowing rather than by production taxes. In other words, the selection of a financing scheme for public infrastructure investment matters. The narrow tax base in the country is an important factor that allows our simulation results to confirm that international borrowing is a better alternative to tax financing, with the goal of improving the economy's physical infrastructure to create job opportunities, improve productivity and complement its social protection measures.

Against this backdrop, the Philippine government needs to become more proactive in finding ways to finance increased public investment expenditures. One important policy response is to fast track public-private partnerships (PPPs), to provide financial and technical assistance for infrastructure projects and to increase public education spending. Another is for the government to source additional international financing at concessional rates, or to devise measures to broaden the tax base to finance public investments.

Providing financing for PPP projects in the Philippines is indeed an important issue. The legal and regulatory environment as well as the institutional framework for PPPs has already been established in the country since the 1990s, with PPPs offering nine contractual arrangements—including build-operate-transfer (BOT), build-own-operate (BOO) and build-lease-transfer (BLT) projects, among others. As of August 2012, there were 22 PPPs in the Philippines, including a school infrastructure project (the PSIP); this project aims to build 9,300 public school classrooms for the Philippine government's Department of Education through a BLT at a total cost of US$239 million. The Philippines has been attracting greater foreign and domestic investments amid improving investor confidence and a liquid financial system. In fact, certain financial institutions—particularly banks and insurance companies—have signalled keen interest in providing financial support for the country's PPP programs, including the PSIP.

To encourage greater private sector participation, government guarantees are being provided to cover the risks inherent to PPP projects. However, if not properly priced and managed, these

guarantees create contingent liabilities that could potentially worsen the government's fiscal risks. The Philippine government thus needs to adopt a better framework for granting guarantees: it should include a more accurate pricing mechanism—such as a guarantee fee that fully takes into account the different risks of the project and market conditions—in order to ensure a more efficient allocation of government resources (Llanto, 2007). A potential area for future research is to simulate the macroeconomic, sectoral, poverty and income distribution impacts of public infrastructure spending in each key infrastructure sector in the Philippines: education, power, telecommunications, transportation and water. Such an initiative will help policymakers in the country as well as donor agencies better allocate their resources to fund the development of each infrastructure sector, thereby promoting inclusive growth and alleviating poverty and income inequality.

REFERENCES

Araar A. and J.-Y. Duclos. 2009.User Manual for Distributive Analysis STATA package (DASP). Universite Laval, Quebec.

Aschauer, D. 1989. Is Public Expenditure Productive? Journal of Monetary Economics 23, pp.177-200.

Asian Development Bank (ADB). 2007. *Philippines: Critical Development Constraints*. Manila.

Albert, J.R. and P. Collado. 2004. Profile and Determinants of Poverty in the Philippines. 9th National Convention on Statistics, Mandaluyong City.

Arslanalp, S., F. Bornhorst and S. Gupta. 2011. Investing in Growth. Finance & Development 48:1, pp.34-37. March.

Calderon, C. and A. Chong. 2004. Volume and Quality of Infrastructure and the Distribution of Income: An Empirical Investigation. *Review of Income and Wealth*, 50, pp. 87-105.

Cockburn, J., J.-Y. Duclos and L. Tiberti. 2011. Notes on Microsimulation model and results for Benin, mimeo, PEP document prepared for the PEP-AusAID project "Simulating the distributive impacts of different growth strategies."

Corong, E., R. Reyes and A. Taningco. 2010. Poverty Impacts of Preferential and Multilateral Trade Liberalization on the Philippines: A Computable General Equilibrium Analysis. MPIA Working Paper 2010-06. Poverty & Economic Policy (PEP) Research Network.

Cororaton, C., and E. Corong. 2009. Philippine Agricultural and Food Policies: Implications for Poverty and Income Distribution. International Food Policy Research Institute (IFPRI) Research Report No. 161. Washington DC: IFPRI.

Dissou, Y. and S. Didic. 2011. Public Infrastructure and Economic Growth: A Dynamic General Equilibrium Analysis with Heterogeneous Agents. Department of Economics, University of Ottawa.

Duclos, J.-Y. and A. Araar. 2006. Poverty and Equity: Measurement, Policy, and Estimation with DAD. Springer: New York.

Foster, J.E., J. Greer and E. Thorbecke. 1984. A Class of Decomposable Poverty Indices. *Econometrica*, 2:81, pp.761-766.

Gupta, S., A. Kangur, C. Papageorgiou and A. Wane. 2011. Efficiency-Adjusted Public Capital and Growth. IMF Working Paper 11/217. Washington DC: International Monetary Fund.

Ibazeta, J. 2010. The Power Outlook. Presentation to the Philippine Economic Society, NEDA sa Makati Building, Makati City. 29 June.

Isaksson, A. 2009. Public Capital, Infrastructure and Industrial Development, UNIDO Working Paper 15.Vienna: United Nations Industrial Development Organization.

Llanto, G. 2007. Dealing with Contingent Liabilities: The Philippines,in T. Ito and A. Rose (eds.) Fiscal Policy and Management in East Asia. The University of Chicago Press.

National Statistics Office. (n.d.). Labor Force Survey, various issues.

National Statistical Coordination Board. 2008. 2008 Philippine Statistical Yearbook. Makati City.

Paderanga, C. 2010. The Philippine Economy: Performance, Prospects, Challenges, and Strategies. Presentation at the House of Representatives, Quezon City, Philippines. September.

Savard, L. 2010. Scaling Up Infrastructure Spending in the Philippines: A CGE Top-Down Bottom-Up Microsimulation Approach. *International Journal of Microsimulation*, 3:1, pp. 43-59.

Teruel, R. and Y. Kuroda. 2005. Public Infrastructure and Productivity Growth in Philippine Agriculture, 1974-2000. *Journal of Asian Economics*, 16:3, pp. 555-576.

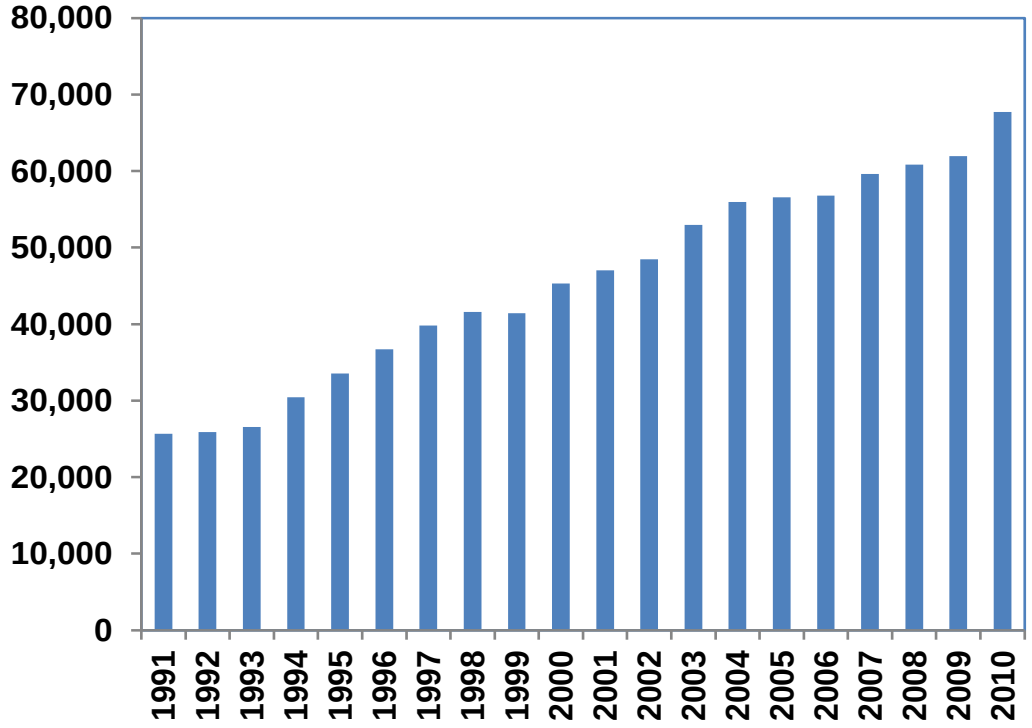
World Development Indicators Database. 2009. The World Bank. Washington D.C.

World Economic Forum. 2010. The Global Competitiveness Report 2010-2011. Geneva.

Zhai, F. 2010. The Benefits of Regional Infrastructure Investment in Asia: A Quantitative Exploration. ADBI Working Paper 223. Tokyo: Asian Development Bank Institute.

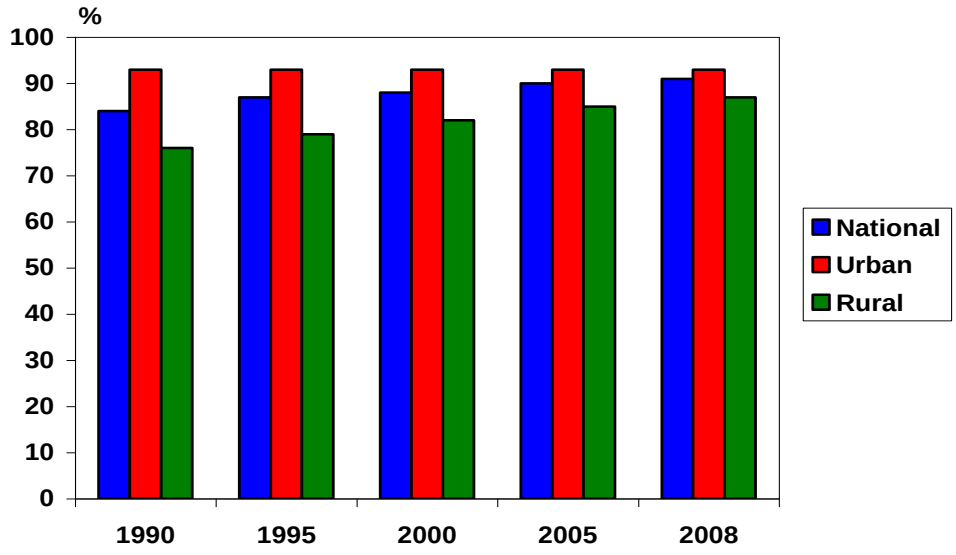
APPENDIX A: FIGURES

Figure A1. Power generation/consumption in the Philippines, 1991–2010 (gigawatt-hours)



Source of basic data: Department of Energy, Republic of the Philippines.

Figure A2. Proportion of population with access to improved water source in the Philippines : 1990, 1995, 2000, 2005, 2008



Source of basic data: The World Bank's World Development Indicators Database.

APPENDIX B: TABLES

Table B1.
Poverty incidence for selected subpopulation characteristics based on 2006 Philippine FIES

Variable	Estimate	Standard Error	Variable	Estimate	Standard Error
Type of household			**Class of worker (household head)**		
Single household	0.277	0.003	Worked for private Establishment	0.257	0.004
Extended household	0.249	0.004	Work for the government	0.194	0.008
			Self-employed without any employee	0.347	0.004
			Employer in own family-operated	0.237	0.008
Headship			Worked with pay in own family-op	0.173	0.051
Male headed	0.286	0.002	Worked without pay in own family	0.165	0.026
Female headed	0.202	0.005			
Marital status of household head			**Number of members Employed**		
Single	0.171	0.010	1	0.284	0.004
Married	0.283	0.003	2	0.267	0.004
Widowed	0.233	0.006	3	0.259	0.007
Divorced/separated	0.199	0.014	4	0.273	0.011
Unknown	0.463	0.250	5	0.297	0.020
			6	0.306	0.041
Job status of the household head			7	0.273	0.077
with job/business	0.182	0.005	8	0.161	0.107
no job/business	0.287	0.002			

Source: Authors' computations using FIES.