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Welfare Gains from Reducing the Implementation Delays in Public Investment

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Welfare Gains from Reducing the Implementation Delays in Public Investment

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Abstract

This paper studies the welfare impact of a reform that reduces the completion duration of public capital. For a sample of emerging economies, I inspect the welfare gains from shortening the completion time from 10 to 3 years by tailoring a parsimonious general equilibrium model. My analysis reveals sizable gains from the reform. For the mean emerging country in the sample, the reform brings about 1.53 percent benefits in terms of compensating variation in consumption. Rising social demand for public investment under a shorter implementation duration moves the economy towards a higher public capital to output ratio, which leads to higher levels of private investment and consumption, bringing notable welfare gains. Most of the gains accrue within 15 years after the reform. For certain countries, such as Thailand, Romania, Russia, and India, the gains emerge as remarkably large, whereas for another group that includes Serbia, Bulgaria, Phillippines, and Argentina, the gains turn out to be modest.

Keywords: Public Investment; Time-to-Build; Externalities; Welfare
JEL classification: E22; E62; H30; H54

1 Introduction

Public capital is a crucial ingredient to the production potential of a country. Above all, it encompasses the nation's stock of infrastructure and the other public goods, providing extreme positive externalities to the rest of the economy. In particular, a change in the country's position regarding the public capital shifts the productivity of its private sector. The accumulation of public capital happens through streams of public investment spending. With the recent slowdown in global economic activity that is considered by many as being persistent, the potential

role of public investment in reviving the economy has also been emphasized more than ever, both for the advanced and emerging economies[1].

Notwithstanding its critical role in functioning of an economy, public investment is also prone to several severe problems that are common to affairs involving state intrusion and political influence. A non-exhaustive list of factors that bring such problems includes bureaucratic inefficiencies, inept, or inadequate monitoring, corruption, nepotism, and distorted cost-benefit assessment. Among other unwanted consequences, all of these problems are likely to end up in implementation delays. In a recent study, Brumby and Kaiser (2012) emphasize the concerns about time delays and waste on fiscal stimulus packages involving public infrastructure investment. They also refer to Construction Sector Transparency Initiative data[2] as an evidence that time overruns are more prevalent and more punishing than cost overruns. Similarly, Gemmell et al. (2012) underline that the public infrastructure projects are subject to time delays even in developed countries, hindering their ability to provide fiscal stimulus in the short-run. They also signal that the implementation lags could be more of a problem for developing countries given their inferior standing on the administrative capacity. Consistent with these observations, on-time implementation has been identified as one of the three pillars on which quality of public investment practices rests within the recently established Public Investment Management Assessment (PIMA) Framework of the International Monetary Fund (see International Monetary Fund, 2015). The economic benefits of an improvement on this core pillar are not studied in the previous literature, although there are a few studies that emphasize that implementation delays are important in determining the impact of public investment on the economy as a whole. As a recent example Leeper et al. (2010) incorporate time-to-build structure on public investment to show that such implementation delays may reduce and sometimes completely undo the beneficial impact of fiscal stimulus programs both in the long-run and short-run. Elekdag and Muir (2014) emphasize that implementation delays may weaken the beneficial impact of the public investment program in Germany. Bouakez et al. (2014) argue that the impact of a fiscal stimulus program that includes public investment spending crucially depend on the extent of implementation delays, especially when the economy is at the zero lower bound.

Previous literature about government efficiency, especially Dabla-Norris et al. (2012), signals that emerging and developing countries have a lot of room for improvement in public investment management. Further, the recent initiatives taken by important international organizations, such as the International Monetary Fund, the World Bank, the OECD, and the G-20 presidencies

[1] As an example, boosting infrastructure investment has been one of the main focus points during G-20 presidencies of both Australia (2014) and Turkey (2015).

[2] See also Construction Sector Transparency (2011).

of Australia and Turkey in 2014 and 2015, all emphasize the importance of good governance with a focus on public investment. These efforts are largely perceived as being very punctual and to the point when the World economy is in dire straits to overcome the growth and productivity bottlenecks that have emerged in recent years following the Great Recession.

While the benefits from an improved government efficiency are numerous, this paper focuses on a very particular potential benefit; the reduction in implementation delays in public investment. Public investment streams can be regarded as additions to the public capital stock; but to the extent that the government efficiency permits, as argued by Pritchett (2000). The public capital, which we can think of as the infrastructure stock in the economy, brings significant positive externality to the economy and boosts the productivity of private sector factors of production. The implementation delays simply postpone the transformation of public investment spending into public capital stock. The resources of the society are allocated to public investment in the current period, but those resources become productive only after a certain time delay. Clearly, if the undue delays are reduced by reforms that target a more efficient government, the potential benefits to the society may be significant. The particular reform studied in this paper is one which reduces the duration of completion of the public capital from 10 years to 3 years. This experiment is inspired by the recent experience of Turkey. According to the data from the Ministry of Development, the average duration of completion of public capital has declined from 10.7 years to 3.7 years between the years 1996 and 2016. This period also coincides with an era of remarkable improvement in the Public Investment Efficiency (PIE) indicator that I construct using the sub-indices of the World Bank's Worldwide Governance Indicators. In other words, the Turkish data signals a significant negative correlation between the efficiency indicator and the implementation delays. I study the impact of such a decline in the completion duration for a "representative" emerging country that bears the average characteristics of a group of emerging countries that are in relatively bad standing with respect to government efficiency. I find that the gains from this just one benefit from an improved public investment efficiency are indeed sizeable. For the "average" emerging country in the sample, the welfare gains from such a reform are 1.53 percent in terms of compensating variations in consumption. Under alternative but still plausible parameter values, the gains can reach towards 2 percent, and in certain cases, over 2 percent.

A background model is needed in order to run a formal welfare analysis of a reform on implementation delays. I keep the model as simple as possible in order to study the welfare effect of reducing the implementation delays in public investment transparently and in an isolated fashion. The starting point is the canonical real business cycle model. The public sector investment and capital need to be modeled to address the questions of this paper. The public

sector capital is incorporated into the production function of the economy as bringing positive externalities like Baxter and King (1993). The public capital is assumed to be subject to a time-to-build constraint like in Wen (1998) in order to be able to capture implementation delays. Next I consider two economies: First, the S (slow) economy where the establishment of public capital requires a long period of time, second the F (fast) economy, where the public capital is formed relatively quickly. The S and F economies are otherwise identical. The two models are then parameterized, calibrated, and solved. Next, Hicksian compensating variations are calculated to measure the welfare gains from a reform that reduces the implementation delays.

The high welfare gains stem from the fact that a reduction in implementation delays leads to a higher social demand for public investment, as the latter becomes productive more quickly. As a result, the economy converges to a new steady state with a higher public capital to output ratio. While the private capital to output ratio is independent of the stance of the implementation delays, the private investment also increases in levels because the higher public capital intensity boosts private sector productivity and output. After the reform, the economy shifts towards a more investment intensive economy in the sense that the share of overall investment in output is higher and the share of consumption is lower. Nevertheless, consumption also increases in levels because of the output boost, leading to significant welfare gains.

The Hicksian compensating variation figures are computed as unconditional on the state variables. In other words, they measure the long-run consequences of the reform, after all the benefits are realized. The model implies that the welfare benefits of the reform are reaped wholly by the 30th year after the reform, while a major portion of the gains (about 88 percent) accrues within the first 15 years. The public capital build-up is especially rapid in the initial periods in the post-reform era when the public investment overshoots its new long-run value. During this rapid build-up, the private investment and the private consumption are crowded-out. These variables return to their pre-reform levels within 6 and 7 years, respectively. Thereafter, they converge to their higher long-run levels, when the benefits of higher public capital to output ratio manifests itself. As implied by the crowding-out of the private consumption and investment, the gains from the reform are much smaller when the welfare calculations are conditional on the pre-reform states.

In general, the welfare gains from reducing implementation delays are higher the more flexible is the economy. Welfare gains turn out to be bigger the less is the risk aversion of the agents, the more flexible is the labor supply, and the more significant are the economy-wide positive externalities. Another finding is that the amount of welfare gains quantitatively depends on the distribution of the relative importance of investment in a particular period throughout the duration of completion. In particular, if the projects are front-loaded, that is, an ample amount

of investment is needed at the initial periods to complete a project, the welfare gains from the reform are significantly higher, and vice-versa.

The welfare gains from the reform are found to be more pronounced for certain emerging countries. The only Asian tiger in the sample, Thailand, seems to be the country that would benefit the most from a reform that reduces the implementation delays with a welfare gain close to 4 percent. Other countries with significant welfare gains are Romania, India, Russia, Paraguay, Peru, Ukraine, and Vietnam, all registering gains greater than 1.5 percent. The countries with significant welfare gains are those with historically high investment rates. The results show that, while the historical shares of high public investment and capital are more instrumental in determining the gains from the reform, private rates of investment and capital accumulation are also important as a reform in the public sector boosts marginal productivity in private investment as well. The country-specific results also point out another interesting fact: Some of the countries with significant potential welfare gains from reducing implementation delays are those with a lot of leeway in improving government efficiency. One notable example is Paraguay. Ranking the emerging countries with respect to their relative standing in government efficiency, Paraguay is the worst country in the sample. On the other hand, the welfare gains from a reform reducing the implementation delays are found to be over 1.8 percent. In other words, a public sector reform is clearly called for this country, and the gains from only one dimension among many others, i.e., shorter public investment completion times, are remarkable. There are other countries in the sample with a lot of potential for improvement in the public sector efficiency, for which the welfare gains from the reform in implementation delays are found to be enormous. Particular examples along this line are Russia, India, Ukraine, and Vietnam.

My findings are consistent with the findings of some of the recent papers exploring the effects of public investment. Eden and Kraay (2014) document that the private investment is crowded in by public investment in the long-run for a group of developing economies. So the mechanism in my paper, that is, the increasing public capital drives the private investment up as well, has an empirical backing. The results also concur with the findings of Abiad et al. (2015). They inspect the macroeconomic effects of public investment for a group of advanced countries. One of the findings they reach is that an increase in public investment increases output both in the short-run and in the long-run due to demand and supply effects respectively, exactly in line with the implications of the model of this paper. Another finding they reach is that these effects are larger the higher the efficiency in public investment. We can regard the reduction in implementation delays as an efficiency gain. In this regard, this finding of Abiad et al. (2015) also support the results of my paper. Another paper that argues that the effect of public investment is conditional on efficiency is Shankha and Era (2011). They propose a growth model

in which the additions to public capital is subject to leakages due to efficiency losses. In another recent empirical analysis, Box 3.4 in International Monetary Fund (2014) shows for a group of low-income countries that an increase in public investment leads to an increase in public capital and growth, and the positive impact is greater the greater the efficiency of public investment. My analysis is in concordance with this empirical finding. Besides, my findings indicate that a higher efficiency itself brings about a higher investment, and thus a higher capital stock.

2 Model

The model I will use in the welfare analysis is a simple extension of the baseline real business cycle model. The model features households, firms, and a government. The government undertakes public investment to build public sector capital, but under a time-to-build constraint. Households are identical and can be represented by a representative household. The problem of the representative household is stated below:

$$\underset{\{c_t,n_t\}_{t=0}^{\infty}}{Max} \quad E_0 \sum_{t=0}^{\infty} \beta^t U\left(c_t, n_t\right) \tag{1}$$

$$s.t.$$

$$c_t + i_t + T \leq w_t n_t + q_t k_{t-1} \tag{2}$$

$$k_t = \left(1-\delta\right) k_{t-1} + i_t \tag{3}$$

The households take utility from consumption, c_t, and disutility from working a fraction n_t of their time at firms for the wage w_t. The households also invest, i_t, and accumulate capital, k_t, which is subject to depreciation at rate δ. The government receives a lump-sum tax of T from the households each period.

The output of the economy, y_t, is produced by perfectly competitive firms. The firms require public sector capital $\bar{k}$ as well as labor effort, n^F,and capital, k^F for production:

$$y_t = e^{z_t} f\left(n_t^F, k_t^F, \bar{k}_{t-1}\right). \tag{4}$$

The public capital is provided at no cost to the private sector, reflecting the positive externality it creates. Also, in this sense, I assume that the production function exhibits constant returns to scale in private inputs, but the presence of public capital leads to increasing returns to scale in the economy as a whole.

The production is subject to an exogenous shock modeled as a first degree autoregressive

process as usual.

$$z_t = \rho z_{t-1} + \epsilon_t, \qquad \epsilon_t \sim N\left(0, v^2\right). \tag{5}$$

The firms maximize their profits, π_t, by choosing how much labor and capital to employ given the factor prices and the public capital provided by the government:

$$\underset{k_t^F, n_t^F}{Max} \;\; \pi_t = y_t - q_t k_t^F - w_t n_t^F. \tag{6}$$

The only role the government plays in this economy is to undertake public investment and accumulate public capital. The critical assumption is that the public capital accumulation is subject to a time-to-build constraint in the spirit of Wen (1998):

$$\bar{k}_t = (1 - \delta_g)\, \bar{k}_{t-1} + m_t, \tag{7}$$

$$m_t = g\left(\bar{\imath}_t, \bar{\imath}_{t-1}, ..., \bar{\imath}_{t-M+1}\right), \tag{8}$$

where g is a concave, twice continuously differentiable function that depends positively on its arguments and has the constant returns to scale property. The formulation above postulates that a series of investment flows for M periods are required to build public capital stock. This formulation nests the pure gestation lags approach to time-to-build, similar to the approach adopted by Kydland and Prescott (1982). I opt for Wen formulation because it models time-to-build more realistically in the sense that some investment is needed each period to complete a project. That is, the resources allocated to investment become at least partially productive immediately[3]. Further, as demonstrated by Wen (1998), this formulation remedies the Rouwenhorst's (1991) criticism that the time-to-build feature is not instrumental in explaining the aggregate fluctuations.

For the time being, I will assume that the government finances its periodic investment by lump-sum taxation.

$$\bar{\imath}_t = T_t. \tag{9}$$

Later on, I will discuss the impact of fiscal policy.

The government maximizes the lifetime utility of the representative agent when choosing how much public investment to make while taking the decisions of the representative agent, c_t^*, n_t^*, and i_t^*, and the decisions of firms, n_t^{F*}, and k_t^{F*}, as given, subject to the economy-wide

[3] In this respect, the assumption of pure-gestation lags would overstate the welfare benefits from a reduction in implementation delays. I will return to this point when I discuss the results under alternative assumptions about parameter values.

resource constraint:

$$\underset{\{\bar{\imath}_i,\bar{k}_t\}_{t=0}^{\infty}}{Max} \quad \sum_{t=0}^{\infty} \beta^t U\left(c_t^*, n_t^*\right) \tag{10}$$

$$s.t.$$

$$c_t^* + i_t^* + \bar{\imath}_t \leq e^{z_t} f\left(n_t^{F*}, k_t^{F*}, \bar{k}_{t-1}\right) \tag{11}$$

$$\bar{k}_t \leq (1-\delta_g)\,\bar{k}_{t-1} + g\left(\bar{\imath}_t, \bar{\imath}_{t-1}, ..., \bar{\imath}_{t-M+1}\right). \tag{12}$$

The equilibrium takes place in this economy when the agents solve their problem optimally and the markets clear. In other words, at the equilibrium, the choices of the households, c_t^*, n_t^*, k_t^*, i_t^*, the choices of the firms, n_t^{F*}, k_t^{F*}, and the choices of the government, $\bar{k}_t^*$, $\bar{\imath}_t^*$, and T_t^*, are consistent with each other. Hence, the following conditions hold at the equilibrium:

$$n_t^* = n_t^{F*} \tag{13}$$

$$k_{t-1}^* = k_t^{F*} \tag{14}$$

$$c_t^* + i_t^* + \bar{\imath}_t^* = y_t^* \tag{15}$$

3 Social welfare and the completion duration of public capital

Social welfare is measured as the lifetime utility of the representative household. Let us assume that there are two economies. The economies are identical except the completion duration of the public capital. The public capital takes M_S periods to build in the slow economy, and M_F periods in the fast economy, with $M_F < M_S$. The lifetime utility functions of the agents in each economy are given below:

$$V^i\left(s_t^i\right) = E_t \sum_{j=0}^{\infty} \beta^j U\left(c_{t+j}^{*i}, n_{t+j}^{*i}\right), \quad i = S, F. \tag{16}$$

Above, s_t denotes the vector of state variables, and is given as $s_t^i = [k_{t-1,}\bar{k}_{t-1}, z_t, \bar{\imath}_{t-1}, ..., \bar{\imath}_{t-M_i+1}]$ for economies $i = S, F$. I will use economies S and F to study the potential welfare gains that can be capitalized by a reform that reduces the completion duration of public capital stock. It is evident from the model built in previous section that such a reform will bring welfare benefits. The underlying mechanism can be best understood by inspecting the first order condition on

public investment:

$$\begin{aligned}\lambda_t &= \psi_t \frac{\partial g\left(\bar{\imath}_t, \bar{\imath}_{t-1}, ..., \bar{\imath}_{t-M+1}\right)}{\partial i_t} \\ &\quad + \beta E_t \psi_{t+1} \frac{\partial g\left(\bar{\imath}_{t+1}, \bar{\imath}_t, ..., \bar{\imath}_{t-M+2}\right)}{\partial i_t} \\ &\quad \cdots \\ &\quad + \beta^{M-1} E_t \psi_{t+M-1} \frac{\partial g\left(\bar{\imath}_{t+M-1}, \bar{\imath}_{t+M-2}, ..., \bar{\imath}_t\right)}{\partial i_t}.\end{aligned} \tag{17}$$

The symbols λ_t and ψ_t above stand for the Lagrange multipliers associated with the economy-wide budget constraint and the law of motion of the public capital stock, respectively. Hence, the former measures the social utility cost of allocating one unit of resources to public investment in the current period, where the letter measures the indirect social utility from an extra unit of public investment today. As seen from equation (17), not all the benefits of an extra public investment today will accrue the next period. The benefits of a unit of public investment are rather distributed M periods into the future due to the time-to-build assumption. Note that these benefits that will be realized in the future are discounted because the agents are impatient; the consumption today is valued more than the consumption in the future. Therefore, a structural reform that ends up shortening the completion time of public investment projects will urge the households to demand more public investment, that is the social demand for public investment will increase, as it becomes productive more quickly compared to before, with all the externality it creates. As a result, the economy will converge to a new steady state with a higher public investment and public capital to output ratio[4]. This, in turn, drives up the private investment because the productivities of the private factors are driven up, and an output boost takes place as well. As a result, both the public and the private capital stock will be higher compared to their levels before the reform. The economy will end up with a higher level of consumption, suggesting welfare gains from the reform.

The benefits from the reform are potentially significant in particular because the public investment in practice is directed to infrastructure build-up, creating public goods that are thought to be the most significant source of the economy-wide positive externality. The public capital stock is incorporated in the model reflecting this fact by assuming that it leads to positive externality for the economy as a whole. Nevertheless, in the transition period, the gains are expected to be much smaller if any, because the economy will build up the new capital in this period, and the ample resources created by this development will only be available after the

[4] I will prove this statement below after the functional forms are assigned.

stock is built. While I focus on the long-run implications in this paper, I will also calculate the transitional implications of the reform.

We can think of time delays in the implementation of public investment as an efficiency loss within the terminology of Pritchett (2000). He proposes the use of a public capital accumulation equation that incorporates the efficiency of public investment in the following way:

$$\bar{k}_t = (1 - \delta_g)\, \bar{k}_{t-1} + \gamma_t \bar{\imath}_t.$$

Above, γ_t is a fraction. Therefore, Pritchett's formulation above suggests that some fraction (and possibly all) of today's investment spending never turns into productive capital. In this paper, investment spending is never "lost"; it becomes productive at some point in the future. Nevertheless, unnecessary time-delays reduce the value of the resources allocated to current investment spending significantly due to discounting[5]. In this respect, reducing the implementation delays may be regarded as an efficiency gain.

The welfare impact of the reform will be measured by Hicksian compensating variations (HCV). I mainly focus on the long-run implications[6]. Therefore, I will calculate the unconditional HCV, λ^U as follows:

$$E\left[V^F\left(s_t^F\right)\right] = E\sum_{j=0}^{\infty} \beta^j U\left(\left(1+\lambda^U\right) c_{t+j}^{*S}, n_{t+j}^{*S}\right) \tag{18}$$

HCV thus measures the time and state independent increase in consumption that needs to be given to the households in the slow economy so that they get the same lifetime utility as the households in the fast economy.

I will also inspect the welfare impact in the transition period. This time, HCV can be calculated by conditioning on the states in the pre-reform economy, i.e., the slow economy, S.

$$V^F\left(s_t^S\right) = E_t\left[\sum_{j=0}^{\infty} \beta^j U\left(\left(1+\lambda^C\right) c_{t+j}^{*S}, n_{t+j}^{*S}\right) \mid s_t^S\right] \tag{19}$$

In general, λ^C will depend on the particular realization of the state vector, s_t^S. Therefore, the joint probability distribution of the state variables in the slow economy, s_t^S needs to be calculated. I infer this distribution from a fairly long (one-million periods) simulation of the

[5] A unit of current resources allocated to an investment that will be productive M years into the future will lose $\left(1-\beta^M\right)$ percent of their value from the society's perspective.

[6] See Lester et al. (2014) for a nice presentation of the unconditional and conditional welfare concepts.

slow economy. Then I specify a grid of states s_t^S and calculate λ^C at each state. The resulting vector of compensations is weighted according to the probability of occurrence of each state.

4 Recent Developments in Government Effectiveness

In June 2015, the International Monetary Fund (IMF) established the Public Investment Management Assessment (PIMA) framework that aims to discipline the assessment of practices across countries (see International Monetary Fund, 2015). According to PIMA, a proper assessment of public investment management covers three stages; i) Planning, ii) Allocating, and iii) Implementing. The first checks whether the public investment is at sustainable levels, while the second deals with whether the appropriate sectors are chosen or targeted. The third pillar of assessment inspects if the projects are implemented on time and on budget. This paper is dealing with the last one, the implementation on time, keeping the stance on the other two pillars unchanged. The welfare gains from an improvement in this single aspect of public investment management are quite significant according to my findings. Therefore, the effect of a public investment management program that brings improvements in all three pillars can potentially be sizable.

The model allows us to transparently study the effects of a reform that reduces the implementation time of the public investment. The number of periods required for the completion of public capital, M, is a parameter in the economy and can be set to any positive integer. Although implementation delays are often cited as an important phenomenon from the public management perspective, data on the average completion duration is not available for any country, unfortunately. Even the anecdotal evidence is scarce. As a rare example, the data from the Ministry of Development of the Republic of Turkey indicates that average duration of completion for public capital declined from 10.7 years in 1996 to 3.7 years in 2016. While such an improvement may be merely an artifact of the evolution of the sectoral distribution of public investment spending, there is some evidence that it is also likely to be related to improvements in government efficiency. In a recent article, Erdis (2013) studies the impact of the new Public Procurement Law enacted in 2003 in Turkey. The new law was a part of the harmonization process of the European Union (EU) accession of Turkey, and thus was basically a rewrite of the previous law based on the foundations of EU public procurement system. Erdiş notes that the objective behind the enactment of the new law was to "contribute to the effective use of public resources by providing a competitive market and transparency in public procurement tenders". The author takes into account 1453 public construction projects within the 2002-2009 period.

Nearly 60 percent of them were tendered under the old law, where the rest were tendered under the new law. He then examines whether the new law had led to a reduction in duration and cost deviations. According to the findings of the author, 50 percent of the projects were finished with a delay under the old law, where under the new law, only 20 percent were completed with a delay. Furthermore, nearly 11 percent of the projects were finished later than 20 percent of the initial estimate of duration, and 31 percent was delayed with more than 40 percent. The author documents that these numbers decreased to 3 and 9 percent respectively under the new law. These findings constitute a good example as to how an improvement in good governance contributes to the reduction in implementation delay in public investment[7].

In this paper, the public investment efficiency (PIE) is proxied by a composite of three of the indices included in the Worldwide Governance Indicators (WGI) of the World Bank; the Control of Corruption, the Regulatory Quality, and the Government Effectiveness. The three indices are aggregated by a simple summation, and the country percentile rankings with respect to this sum is calculated to measure a country's particular standing vis a vis the rest of the world and its peers. International Monetary Fund (2015) stresses that the implementation stage of the public investment is effected by the integrity of the public investment process as a whole. In this regard, they include a measure of corruption, specifically, the corruption index of the International Country Risk Guide (ICRG) in the assessment of the public investment performance of the countries. The corruption has been regarded as a primal culprit in ruining the public investment efficiency[8]. The regulatory quality and the government effectiveness can also affect implementation delays by affecting the required red-tape, and the overall efficiency of the public investment management. Figure 1 depicts that, the PIE proxy shows a remarkable negative correlation with the completion duration for Turkey within the sample period. While other factors might have played a role, I regard this finding as an evidence as to how better governance leads to efficiency gains in public investment management, in particular, a reduction in implementation delays.

In Figure 2, I depict the historical development in the public investment efficiency proxy for a selection of 31 countries, which are usually grouped as the emerging economy (EE) countries. For expositional purposes, I also group the EE countries into six subgroups, according to their average PIE proxy score within the sample period. The EE countries in group 6 are really at

[7] The July 2002 Letter of Intent of Turkey to the IMF also emphasized the commitment of the local authorities to reduce the average project completion time in the public investment program by adopting an action plan in September 2002.

[8] Tanzi and Davoodi (1997) provides evidence on the harm that corruption does on public investment efficiency. Although they do not take into account implementation delays, they underline that corruption reduces the productivity of each dollar spent on building public capital.

developed country standards in terms of their performance regarding the PIE proxy. The same can be said for the EE countries in group 5. The improvement that Lithuania and Poland had recently attained is remarkable. On the other hand, the decay in South Africa's performance seems alarming.

The countries in groups 1-4 are the EE countries that seem to have problems regarding public investment efficiency. While some countries such as the ex-Iron-Curtain countries have exhibited significant improvement, the problematic performance on the PIE proxy looks chronic. Many countries in these groups have periods of improvement and decay in public investment efficiency, and those who have showed improvement seem to get stalled at a certain point. As a consequence, I regard the EE countries in groups 1-4 as the ones that have a significant room for improvement in public investment efficiency. Thus the impact of a reform on implementation delays will be studied for these 20 countries in the rest of the paper[9][10].

5 Impact of a reform on implementation delays

The impact of a reform that shortens the completion time of public investment projects will be studied in this section. Unfortunately, international data on completion duration does not exist. So in light of the evidence from Turkey, I will set the duration in the slow economy to a fairly long period, in particular, 10 years. For the fast economy, I will take the number used by Leeper et al. (2010) and Elekdag and Muir (2014) for the US and Germany respectively, namely 3 years. Next, I will calibrate the model, solve it and calculate the Hicksian compensating variation.

Twenty emerging countries that are in similar or worse standing in public investment efficiency compared to Turkey are included in the analysis. The countries in the sample clearly display a significant level of heterogeneity, as can be observed from Tables 1 and 2. Nevertheless, I will start by running the experiment for a "representative" emerging country that

[9] The Public Investment Management Index that was put forth by Dabla-Norris et al. (2012) is arguably a better indicator for inferring country positions in terms of implementation delays in public investment. Nevertheless, the PMI pertains only to the year 2010, and only 10 of the 20 emerging countries in my sample are covered therein. However, the country rankings with respect to PMI and the 2010 value of the PIE proxy show a positive relationship between the two indicators. I also have inspected an alternative indicator that is comprised of the Corruption and the Bureaucratic Quality indices under the International Country Risk Guide. Although not reported here to save space, the two indicators exhibit remarkable similarity for the 20 EE countries that are studied in this paper.

[10] It may be regarded as unusual to use a closed economy model when dealing with emerging countries. Nevertheless, the external sector is not instrumental for inspecting the welfare impact of a shortened duration of completion of public investment projects. Besides, the complications from including the external sector would have hampered my efforts to study the effects of such a reform transparently and isolatedly.

is characterized by the average of the individual characteristics of the countries in the sample. That is, I will calibrate the model to the rows titled "Mean" on Tables 1 and 2 to make the main points, analyze the effect of the reform on key variables, and investigate the dependence of the results on alternative calibration schemes. Later, the impact of the reform will be calculated for individual countries in the sample.

5.1 Parameterization

The utility function of the agents will take the common additively separable form.

$$U(c_t, n_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma} + \xi \frac{(1-n_t)^{1-\chi} - 1}{1-\chi}. \tag{20}$$

The parameter σ denotes the coefficient of relative risk aversion. The parameter χ determines the Frisch elasticity of labor supply, ε_f. In particular, $\chi = (1-n)/(n\varepsilon_f)$, where n is the steady state labor effort. The parameter ξ is just a normalization parameter.

The production function is in Cobb-Douglas form in the private inputs. Public capital is modeled as bringing positive externalities as discussed above.

$$y_t = e^{z_t} \left(k_t^F\right)^{\alpha} \left(n_t^F\right)^{1-\alpha} \bar{k}_{t-1}^{\phi} \tag{21}$$

As usual, we have that $\alpha < 1$. The parameter ϕ measures the degree of externality created by public capital on the private sector. I will assume that $\phi + a < 1$ to rule out endogenous growth.

I assume that the time-to-build function $m(\cdot)$ takes the general CES form.

$$m_t = \left(\sum_{j=1}^{M} r_j i_{t-j+1}^{\mu} \right)^{1/\mu}, \ \mu \in (-\infty, 1].$$

The parameter μ is equal to $1 - 1/\varepsilon$, where ε is the elasticity of substitution between investment flows in different periods towards the completion of the project. When $\mu = 1$, the flows in different periods are perfect substitutes and the function is linear. When $\mu \to -\infty$, the flows are perfect complements. The time-to-build function takes the Cobb-Douglas form when $\mu \to 0$. The parameters r_j are the weights of the investment flows in different periods. The completion duration is M periods. The weights will be assumed to be symmetric through time in the baseline scenario. That is, $r_j = 1/M$.

5.2 Calibration Strategy

As the reform is about the within-time distribution of the investment flows, certain parameters such as the discount rate and the depreciation rate are crucial. My calibration strategy will take this observation into account. The period in the model is one year. The discount rate, β, which is the degree of impatience of the households, corresponds to the inverse of the gross real interest rate in the model of this paper. Figure 3 depicts the average real interest rate for the countries in the sample, using the real interest rate data of the World Development Indicators of the World Bank. The sample period for the calculation of the averages varies across countries. As the primary concern is to infer a measure of impatience, periods with high and volatile inflation are left out. This means that the data after the mid-1990s are used for most of the countries. Figure 3 shows that the average real interest rate varies between 3.1 percent and 8.0 percent across countries, ignoring the three Latin American countries, Paraguay, Peru, and Brazil that have extremely high real interest rates. In the baseline scenario, I will use the median rate in the sample, as the high real interest rates that are observed for some of the countries in the sample have little to do with the impatience, but rather reflect factors such as inflation risk and financial factors which are out of the scope of my model. The median real interest rate is 5.24 percent. This corresponds to $\beta = 0.95$. Later on, I will report the results with varying values for β to show the dependence of the results on this important parameter.

The parameters of the utility function, σ, and χ, will each be set to 2 in the baseline calibration. My strategy will be to feed the steady-state versions of the first order conditions with certain macroeconomic ratios calculated from the data and let the pre-reform, slow economy model tell what the values of the rest of the parameters are. In particular, the ratios of total capital, consumption, public investment, and public capital to output are set to their empirical values at the steady state. The households are assumed to allocate one-quarter of their time to labor effort and the rest to leisure, i.e., $n = 0.25$ in the slow economy. Crucial parameters ϕ, α, δ, and δ_G, and the utility function normalization parameter ξ are pinned down this way.

The fast economy will have the same values for the whole set of parameters, except that the completion duration, M, is set to 3 instead of 10. The resulting parameter values for the mean emerging country are summarized in Table 3. Together with the value of the discount factor, the time lapse in the completion of public capital in the slow economy vis à vis the fast economy corresponds to a 15 percent efficiency loss on average. Note that International Monetary Fund (2015) estimates that the inefficiencies in the public investment process cost 30 percent of the potential gains from public investment[11]. This paper can be regarded as implicitly postulating

[11] According to the findings of Gupta and Verhoeven (2001) for a sample of developing countries, the efficiency

that half of such losses are due to undue implementation delays.

Capital/output ratios are calculated by using the PPP based data on capital stock and output in Penn World Tables 9.0[12]. Consumption, investment, and output data are taken from the World Bank's World Development Indicators Database. The data on public capital stock and public investment are taken from the Investment and Capital Stock Dataset of the International Monetary Fund. The total consumption series includes durable goods, which need to be included under the investment in the model of this paper. The data for durable goods is available only for some of the countries in my sample. I have adjusted the share of consumption downwards for that group of countries using the OECD data on their durable goods/output ratio. That ratio is taken to be equal to the average of the ratios for the available countries for the countries that do not have durable goods data. Their consumption is adjusted accordingly.

The persistence of the technology process, ρ, and the volatility of the exogenous shock, v^2, are set so that the model can generate the empirical first-degree autocorrelation and the standard deviation of the filtered output under the slow economy.

5.3 Impact on the steady-state

I start out by first studying the nature of the new steady-state after the reform. In section 3 above, I conjectured that shorter completion durations for public capital would increase the social demand for public investment, moving the economy towards one with a greater public capital to output ratio. This section formally establishes this fact using the economy described above with common functional forms. The proposition below indicates that the public capital to output ratio is higher under the new steady state.

Proposition 1 *The steady state public capital to output ratio is higher, the shorter the completion duration of public capital.*
Proof. *In the Appendix.* ■

Corollary 1 *The level of public capital is decreasing in completion time.*

The corollary follows from the assumption that the public capital displays positive, but diminishing marginal returns. The Proposition 1 thus clearly indicates that the levels of public capital and output will be both higher after the reform. Regarding the private investment, the proposition below establishes that the increase in this variable happens to be only in levels.

losses in public investment processes are so significant that, on average, only about half of the investment effort in dollar terms turn out to be productive capital at the end.

[12] Please see Feenstra and Timmer (2015).

Proposition 2 *The private capital to output ratio is independent of the completion duration of public capital.*
Proof. *In the Appendix.* ■

The Propositions 1 and 2 above implies that the consumption as a share of output will decline after the reform. However, as the output increases in levels, consumption increases in levels as well, as it is a normal good.

The impact of the implementation delays on the labor effort depends on the model parameters and the level of the public capital. Nevertheless, the labor productivity definitely increases after the reform. I establish these results in Propositions 3 and 4.

Proposition 3 *The impact of a shorter completion duration for public capital on labor effort is ambiguous unless the coefficient of relative risk aversion is* 1*, in which case, the labor effort is decreasing in* M*.*
Proof. *In the Appendix.* ■

Proposition 4 *The labor productivity is higher, the shorter the completion duration of public capital.*
Proof. *In the Appendix.* ■

Figure 4 visually shows the comparative statics with respect to main variables under varying levels of completion duration and confirms the predictions of Propositions 1-4.

Next, I inspect the transition of the economy following the implementation of the reform.

5.4 Transition after the reform

Figure 5 depicts the transition of key variables to their new steady-state values following the reform. It is seen from the figure that the reduction in implementation delays immediately causes a steep rise in public investment as the allocated resources become productive much quicker after the reform. The increase in public investment demand from the society, which is met by the benevolent government, causes this variable to overshoot its long-run level, and reach its climax in about 3 years. The private investment is crowded out during this period when the country is accumulating public capital stock very fast. The decrease in consumption by higher government spending happens in the first year after the reform, but the consumption rebounds immediately and stays on an upward trend thereafter. The private investment and consumption bounce back to their pre-reform levels within 6 and 7 years respectively.

The figure demonstrates that the most of the extra accumulation (around 85 percent) of the public capital takes place within the first 9 years after the reform. The adjustment of private capital takes longer, as the private agents also increase their consumption throughout the transition period after the first year. According to my model, the output and the welfare gains from the reform are wholly materialized within 30 years after the reform. Hence, the long-run in the model is about 30 years. Yet, around 88 percent of the gains are obtained within the first 15 years.

5.5 Results under the baseline calibration

The unconditional HCV figures for the baseline calibration are displayed in Table 4. The long-run welfare gains from reducing the completion duration of public capital from 10 years to 3 years are found to be 1.53 percent in terms of the Hicksian compensating variations. Given the parsimony of the model, the welfare gains from the reform are remarkable. The high welfare gains are an outcome of the increasing social demand for public investment under the new, shorter completion duration. Figure 6 depicts the ergodic distribution and the impulse response function of the public investment before and after the reform. As seen from the figure, the increase in public investment is higher on impact after a positive aggregate shock when the completion duration of the public capital stock is shorter. We can observe from the ergodic distribution that the public investment becomes a more dispersed series after the reform, but its mean locates at a higher level as expected in light of Proposition 1. The government chooses a higher level of public investment because that is desirable from the viewpoint of the households, as the public investment becomes productive more quickly, and creates positive externality. Indeed, the public investment as a share of output increases by 0.7 percentage points just because the completion duration is reduced. Consequently, the economy converges to a new steady state with a higher public capital, a higher overall stock of capital, and a bigger output. The economy becomes a more investment-based economy after the reform, in the sense that the weight of total investment increases and the weight of consumption decreases. Nevertheless, the consumption increases in levels, thus welfare gains are attained after the reform. These facts can be observed from Table 5 which displays the theoretical means of the key variables in the stochastic steady-states of the slow and the fast economies. Note that the findings are consistent with some of the recent empirical findings that a greater efficiency in public investment leads to a higher capital stock and a higher growth rate (see International Monetary Fund 2014, for

example)[13].

As seen in Table 6, the reform leads to a much greater volatility in public capital, as the agents use the public capital more intensively after improved efficiency in response to shocks. The mechanism is similar to the one emphasized recently by Cho et al. (2015). Although the resulting higher consumption volatility is welfare decreasing, the increase in the levels of output and consumption that the agents attain by a higher variation in the public capital lead to a first-order increase in the welfare that dominates the detrimental impact of higher volatility.

5.6 Alternative assumptions

The welfare gains from the reform become higher when the economy is more flexible. I first demonstrate this fact by allowing for economy-wide positive externalities like Baxter and King (1991). In this case, the production function is augmented by a factor of externality that is denoted by X_t:

$$y_t = e^{z_t} X_t^{\eta} \left(k_t^F\right)^{\alpha} \left(n_t^F\right)^{1-\alpha} \bar{k}_{t-1}^{\phi}. \tag{22}$$

The parameter η measures the degree of externality. The factor of externality is assumed to be a function of the per-capita values:

$$X_t = \widetilde{k}_{t-1}^{\alpha} \widetilde{n}_t^{1-\alpha} \widetilde{\bar{k}}_{t-1}^{\phi}.$$

In equilibrium, per capita variables are equal to individual variables. As modeled above, we can think of the positive economy-wide externalities as the state of the overall economic climate in the economy, in the sense that X_t scales how well the economy can do in terms of culminating all of its resources and create an output. Allowing for an overall positive externality with a degree of 0.1 increases the welfare gains from the reform to over 1.91 percent. When economy-wide externalities exist between private and public inputs, the positive impact of a shorter completion duration in public capital is amplified. This is because such a specification allows for an additional channel where shorter duration causes private inputs to interact with each other in more productive ways. A more remarkable impact of economy-wide externalities is that even the transitional gains from the reform become significant in this case. The transitional gains without the externalities are about 9 percent of the long-run gains, whereas, with the

[13] The empirical analysis carried out in the Box 3.4 of the October 2014 issue of the World Economic Outlook shows that an increase in the public investment leads to an increase in public capital and growth, and the positive impact is greater the greater the efficiency of public investment. My analysis supports this empirical finding. Besides, my findings indicate that a higher efficiency itself brings about a higher investment, and thus a higher capital stock.

externalities, the transitional gains reach to about 21 percent of long-run gains. This finding highlights that a reform relating to the implementation delays, or in general to efficiency in public investment, would be socially more acceptable if it is preceded by other reforms that establish a better overall economic climate.

Other alternative parameter values that can be regarded as increasing the flexibility of the economy also lead to higher welfare gains from a reform about implementation delays in public investment. As seen in Table 4, assuming that the risk aversion parameter is 1 instead of 2 leads to welfare gains as high as 1.72 percent. On the top of that, if the Frisch elasticity of labor supply is increased by decreasing χ to 1, and further to 0, the welfare gains reach 1.76 and 1.82 percent respectively. The elasticity of substitution between investment flows in different periods seems to be less important in terms of the impact of the reform. Assuming that the investment spendings in different periods are highly substitutable leads to smaller welfare gains and vice versa. But the impact is so small, in the order of 10^{-5}, as seen in Table 4.

I also inspect two alternative assumptions about the within-time distribution of investment flows. In the baseline case, I assumed that the distribution is symmetric across time. In other words, $r_i = ... = r_M = M^{-1}$ for each economy. Now let us assume that more investment is needed in the initial phases of the public investment project. In particular, let us investigate a scenario as such, where half of the project needs to finish in the first seven periods, and the other half needs to be implemented in the remaining three periods. In other words, $r_1 = ... = r_7 = 1/6$, and $r_8 = ... = r_{10} = 1/14$. Under this scenario, the welfare gains reach 2.02 percent. The reason is that a big portion of current investment budget is allocated to projects that will become productive far in the future. The gains are smaller if the opposite assumption is adopted, that is when the investment in late phases of the project are more important. This exercise also highlights why I do not opt for pure gestation lag type of formulas to model the time-to-build structure. Pure gestation lags can be regarded as the extreme case of front-loaded investments in the context of this paper. Setting $r_M = 1$ for the slow and the fast economy leads to a welfare gain of 4.70 percent. So, the rather unrealistic assumption that the entire investment spending in the current period become productive only after M periods clearly overstates the welfare gains from the reform.

Figure 7 displays the welfare gains from reducing the completion duration to 3 years when the duration in the slow economy varies between 4 to 20 years. The resulting figure is slightly convex, and the welfare gain varies between 0.18 percent and 5.18 percent.

5.6.1 Dependence of results on the discount factor

The results reported in the previous sections are expected to be sensitive to the value of the discount factor, as the reform brings a reduction in the implementation delays in public investment. If the agents are assumed to be more impatient, the welfare gains from the reform would be higher. This is because earlier consumption is valued more under higher impatience, and the reduced implementation delays in public investment facilitate bring postponed consumption to earlier periods. The welfare gains from the reform along varying degrees of impatience are reported in Figure 8[14]. As seen in the figure, the gains increase exponentially with the degree of impatience. The sensitivity of the results to alternative assumptions about the discount factor should be clearly kept in mind when reflecting on the numerical results obtained in this paper.

5.7 Fiscal policy

The baseline model assumes that the public investment is financed by lump-sum taxation. In this section, this assumption is replaced by a more realistic fiscal policy. First, let us assume that the government budget is financed by consumption taxes, τ^c, labor taxes, τ^n, and capital taxes, τ^k, each of which follows AR(1) processes,

$$\begin{aligned}
\tau_t^c &= \left(1-\rho^{\tau^c}\right)\bar{\tau}^c + \rho^{\tau^c}\tau_{t-1}^c + \varepsilon_t^{\tau^c}, \quad \varepsilon^{\tau^c} \sim N\left(0, \sigma^{\tau^c}\right), \\
\tau_t^n &= \left(1-\rho^{\tau^n}\right)\bar{\tau}^n + \rho^{\tau^n}\tau_{t-1}^n + \varepsilon_t^{\tau^n}, \quad \varepsilon^{\tau^n} \sim N\left(0, \sigma^{\tau^n}\right), \\
\tau_t^k &= \left(1-\rho^{\tau^k}\right)\bar{\tau}^k + \rho^{\tau^k}\tau_{t-1}^k + \varepsilon_t^{\tau^k}, \quad \varepsilon^{\tau^k} \sim N\left(0, \sigma^{\tau^k}\right).
\end{aligned}$$

Household budget constraint changes to the following under the new assumption about the fiscal policy,

$$\left(1+\tau^C\right)c_t + i_t + T_t \leq \left(1-\tau^L\right)w_t n_t + \left(1-\tau^K\right)q_t k_{t-1} + \delta\tau^K k_{t-1}.$$

Similarly, the budget constraint of the government becomes,

$$\bar{\imath}_t = T_t + \tau_t^C c_t + \tau_t^K q_t k_{t-1} + \tau_t^L w_t n_t - \delta\tau^K k_{t-1}.$$

I will assume that $\bar{\tau}^c = 0.2$, $\bar{\tau}^n = 0.3$, and $\tau^k = 0.15$, and the persistence and the shock volatility of each tax process are 0.9 and 10^{-4} respectively.

[14] In this exercise, the parameters α and ϕ are adjusted to keep great ratios equal to their value in the baseline scenario.

Welfare gains from the reform under the alternative fiscal policy are found to be 1.54 percent. The gains are slightly bigger than the baseline case, because the public investment is more costly to the society when financed by distortionary taxes, and hence it is more beneficial when it becomes productive more quickly. Lastly, I inspect the case of a countercyclical fiscal policy, where shocks to the capital tax and labor tax are each correlated positively with the aggregate productivity shock by a coefficient of 0.7. In this case, I find the welfare gains to be even bigger, 1.55 percent.

5.8 Results for the individual countries

The results for the individual countries are given in Figure 9. The values of certain parameters are the same in all the calculations. Namely, I continue setting $\beta = 0.95$, $\eta = 0$, $\sigma = \chi = 2$, $\mu = 0.5$ like in the baseline calibration. Likewise, the investment coefficients are distributed symmetrically across time. All the remaining parameters are now country-specific. The coefficients of the two types of capital stock, α and ϕ, and the associated depreciation parameters, δ and δ_g, as well as the normalization parameter of the utility function, ξ, are as a whole dictated by each country's own ratios of its total capital, public capital, public investment, and consumption to its output. The persistence of the technology process, ρ, and the standard deviation of the exogenous shock, v, are also country-specific. These parameters are gauged for each country to yield the standard deviation and the first-order autocorrelation of the country's GDP.

The results show that the welfare gains from reducing the completion duration of public capital display quite a bit of heterogeneity across countries. Several remarks are worth mentioning. First of all, Thailand is found to be the country that would benefit most from the reform, with the welfare gains of 3.82 percent. The main characteristic of the Thai economy that bring high welfare gains is the historically high level of public investment rates and public capital stock. As the weight of the public sector investment in the overall economy is quite significant, the gains from an increase in the efficiency of public investment are sizable. Similar arguments go for Romania, for which the welfare gains are found to be 2.81 percent.

No unique, distinguishing character rests with the rest of the countries with sizeable welfare gains, like Russia, India, Ukraine, and Paraguay as can be observed from Table 1. For Russia, the relatively high weight of private sector capital and investment play a bigger role. For Ukraine, the high levels of public and private capital stocks are instrumental. For Paraguay and India, the high rates of public investment are important. The group of countries with relatively smaller gains from the reform is characterized by lower than average public investment and public capital, as well as lower rates of private investment.

The results indicate that some countries, which are historically problematic with respect to the efficiency of the public sector, could attain important gains from shortening the completion duration of public capital. In particular, the countries Russia, India, Ukraine, Paraguay, and India are all in an inferior standing vis a vis the rest of the world in terms of public investment efficiency, as observed from Figure 2. Yet the welfare gains from the reform are found to be over 2 percent for Russia and India, and over 1.5 percent for the other three. It is clear that these countries definitely need a public sector reform, in light of Figure 2. The results about the welfare gains indicate that potential gains from such a reform, even when taking into account only those gains through the improvements in the implementation stage of public investment management, are indeed remarkable.

6 Concluding Remarks

Implementation delays in public investment are the likely outcome of many bad public management practices. This paper studies the welfare impact of a reform that shortens the duration of completion of public capital from 10 to 3 years. I find that, under a conservative calibration of the key parameters, the welfare gains from such a reform are at 1.53 percent in terms of compensating variations in consumption for the "average" emerging country.

The gains follow from a higher social demand for public investment, which translates into a higher public capital to output ratio. According to the model, most of the gains accrue within the first 15 years after the reform, and the whole transition takes about 30 years. The private consumption and investment are crowded out by higher public investment in the initial years of the post-reform period. For this reason, the transitional welfare gains are an order of magnitude smaller than the long-run gains.

I find that the welfare gains from the reform are more significant for some of the emerging countries in the sample. Some of these countries are also in a very poor standing in terms of government efficiency. My analysis suggests that sizeable gains are available for these countries if they adopt policies towards a much-needed improvement in public investment management.

Another finding I reach is that the welfare gains from reducing implementation delays are higher if the economy is assumed to be more flexible. The utmost example in this regard is to allow for economy-wide positive externalities. In this case, not only the long-run gains are higher, but also the transitional gains become larger. Allowing for lower risk aversion and higher elasticity in labor supply also lead to higher welfare gains by letting the private factors adjust more liberally to rising public sector capital intensity.

We do not have data on the completion duration of public capital for the countries in the sample. So I used the scant evidence from Turkey to set the related model parameter. This may be regarded as a limitation of my analysis. However, the figures on comparative statics and sensitivity results show that almost all the variables, including the social welfare, depend on the completion duration almost linearly. So if country specific data about completion duration ever emerges, one can scale the welfare results I obtain accordingly to get what the model of this paper imply about the welfare gains from a reform towards a shorter completion duration of public capital.

I assumed in this paper that the extra public investment is financed within balanced-budget. It would be an interesting extension to include public debt and inspect the effect of a reduction in implementation delays on the public debt to output ratio. I conjecture that, while leading to a higher level of public investment, the reform will not lead to an increase in public debt to output ratio as a result of its positive impact on production and output. This would be in line with some recent empirical findings that conclude that increases in public investment spending will not put pressure on debt sustainability if the government effectiveness is high[15].

Another extension would be to allow for a greater complementarity between the public and private capital than implied by the Cobb-Douglas production function like Eden and Kraay (2014). Such an assumption would likely imply greater welfare gains, because the reform-induced increase in the private investment would be greater, making the output impact of the reform more significant. Lastly, other dimensions of public investment management practices like planning and allocation are definitely worth examining from a welfare perspective.

[15] For example, see the analysis in Box. 3.4 of International Monetary Fund (2014).

References

Abiad, A., D. Furceri, and P. Topalova (2015, May). The macroeconomic effects of public investment; evidence from advanced economies. IMF Working Papers 15/95, International Monetary Fund.

Baxter, M. and R. G. King (1991). Productive externalities and business cycles. Discussion Paper, Institute for Empirical Macroeconomics 53, Federal Reserve Bank of Minneapolis.

Baxter, M. and R. G. King (1993, June). Fiscal policy in general equilibrium. *American Economic Review 83*(3), 315–34.

Bouakez, H., M. Guillard, and J. Roulleau-Pasdeloup (2014). Public investment, time to build, and the zero lower bound. Cahiers de recherche 1402, CIRPEE.

Brumby, J. and K. Kaiser (2012). Public investment management: Challenges and tools. In B. Moreno-Dodson (Ed.), *Is Fiscal Policy the Answer? A Developing Country Perspective*, pp. 109–146. The World Bank.

Cho, J.-O., T. Cooley, and H. S. Kim (2015, April). Business Cycle Uncertainty and Economic Welfare. *Review of Economic Dynamics 18*(2), 185–200.

Construction Sector Transparency (2011, March). Pilot results - briefing note 5. Technical report, Construction Sector Transparency.

Dabla-Norris, E., J. Brumby, A. Kyobe, Z. Mills, and C. Papageorgiou (2012, September). Investing in public investment: an index of public investment efficiency. *Journal of Economic Growth 17*(3), 235–266.

Eden, M. and A. Kraay (2014, February). Crowding in and the returns to government investment in low-income countries. Policy Research Working Paper Series 6781, The World Bank.

Elekdag, S. and D. Muir (2014, December). Das public kapital; how much would higher german public investment help germany and the euro area? IMF Working Papers 14/227, International Monetary Fund.

Erdis, E. (2013). The effect of current public procurement law on duration and cost of construction projects in turkey. *Journal of Civil Engineering and Management 19*(1), 121–135.

Feenstra, Robert C., R. I. and M. P. Timmer (2015). The next generation of the penn world table. *American Economic Review 105*(10), 3150–3182, available for download at www.ggdc.net/pwt.

Gemmell, N., F. Misch, and B. Moreno-Dodson (2012). Public spending and long-run growth in practice: Concepts, tools, and evidence. In B. Moreno-Dodson (Ed.), *Is Fiscal Policy the Answer? A Developing Country Perspective*, pp. 69–107. The World Bank.

Gupta, S. and M. Verhoeven (2001, May). The efficiency of government expenditure: experiences from africa. *Journal of Policy Modeling 23*(4), 433–467.

International Monetary Fund (2014). *World Economic Outlook: Legacies, Clouds, Uncertainties.* Washington (October).

International Monetary Fund (2015). *Making Public Investment More Efficient.* Staff Report, Washington (June).

Kydland, F. E. and E. C. Prescott (1982, November). Time to build and aggregate fluctuations. *Econometrica 50*(6), 1345–70.

Leeper, E. M., T. B. Walker, and S.-C. S. Yang (2010, November). Government investment and fiscal stimulus. *Journal of Monetary Economics 57*(8), 1000–1012.

Lester, R., M. Pries, and E. Sims (2014). Volatility and welfare. *Journal of Economic Dynamics and Control 38*(C), 17–36.

Pritchett, L. (2000, December). The tyranny of concepts: Cudie (cumulated, depreciated, investment effort) is not capital. *Journal of Economic Growth 5*(4), 361–84.

Rouwenhorst, K. G. (1991, April). Time to build and aggregate fluctuations : A reconsideration. *Journal of Monetary Economics 27*(2), 241–254.

Shankha, C. and D.-N. Era (2011, August). The quality of public investment. *The B.E. Journal of Macroeconomics 11*(1), 1–29.

Tanzi, V. and H. R. Davoodi (1997, October). Corruption, public investment, and growth. IMF Working Papers 97/139, International Monetary Fund.

Wen, Y. (1998, May). Investment cycles. *Journal of Economic Dynamics and Control 22*(7), 1139–1165.

Appendix

Proof of Proposition 1

The first order condition of the government's problem with respect to public investment is as below;

$$\begin{aligned}\lambda_t &= \psi_t r_1 i_t^{\mu-1}\left(r_1 i_t^{\mu}+r_2 i_{t-1}^{\mu}+...+r_M i_{t-M+1}^{\mu}\right)^{(1-\mu)/\mu}... \\ &\quad +\beta r_2 i_t^{\mu-1} E_t\psi_{t+1}\left(r_1 i_{t+1}^{\mu}+r_2 i_t^{\mu}+...+r_M i_{t-M+2}^{\mu}\right)^{(1-\mu)/\mu}... \\ &\quad +\beta^2 r_3 i_t^{\mu-1} E_t\psi_{t+2}\left(r_1 i_{t+2}^{\mu}+r_2 i_{t+1}^{\mu}+...+r_M i_{t-M+3}^{\mu}\right)^{(1-\mu)/\mu}... \\ &\quad \cdots\cdots \\ &\quad +\beta^{M-1} r_M i_t^{\mu-1} E_t\psi_{t+M-1}\left(r_1 i_{t+M-1}^{\mu}+r_2 i_{t+M-2}^{\mu}+...+r_M i_t^{\mu}\right)^{(1-\mu)/\mu}.\end{aligned} \tag{A1}$$

The symbols ψ_t and λ_t stand for the Lagrange multipliers on the government capital accumulation equation and the household budget constraint respectively.

The condition (A1) simplifies considerably at the steady state:

$$\lambda = \psi\left(r_1+\beta r_2+\beta^2 r_3+...+\beta^{M-1}r_M\right). \tag{A2}$$

The government's first order condition for public capital yields

$$\psi_t = \beta E_t\left[\psi_{t+1}\left(1-\delta_g\right)+\lambda_{t+1}z_{t+1}\phi k_t^{\alpha} n_{t+1}^{1-\alpha}\bar{k}_{t-1}^{\phi-1}\right]. \tag{A3}$$

The steady state version of (A3) is

$$\psi = \beta\left[\psi\left(1-\delta_g\right)+\lambda\phi\frac{y}{\bar{k}}\right]. \tag{A4}$$

The equation (A2) yields an expression for the ratio λ/ψ, which can be used in (A4) to get the following equation:

$$1 = \beta\left[1-\delta_g+\left(r_1+\beta r_2+\beta^2 r_3+...+\beta^{M-1}r_M\right)\phi\frac{y}{\bar{k}}\right]. \tag{A5}$$

We can solve for $\bar{k}/y$ from the equation above;

$$\frac{\bar{k}}{y} = \frac{\phi\left(r_1+\beta r_2+\beta^2 r_3+...+\beta^{M-1}r_M\right)}{\frac{1}{\beta}-1+\delta_g} \tag{A6}$$

The equation above resembles the usual capital to output ratio formula, except for the term in parenthesis that adjusts for the completion time. Note that the weights are symmetric; that is, $r_1 = r_2 = ... = r_M = 1/M$. Thus we can factor out the r_i terms and evaluate the resulting finite sum to get;

$$\frac{\bar{k}}{y} = \frac{\phi\left(1-\beta^M\right)}{M\left(1-\beta\right)\left(\frac{1}{\beta}-1+\delta_g\right)} \tag{A7}$$

Hence, the steady state public capital to output ratio can be written solely in terms of the model parameters, including the completion duration M. To assess in which direction the public capital depends on the completion duration we can take the derivative with respect to M:

$$\frac{d}{dM}\left(\bar{k}/y\right) = \left[\frac{-\phi}{\left(1-\beta\right)\left(\frac{1}{\beta}-1+\delta_g\right)}\right]\left[\frac{M\beta^M\log\beta+1-\beta^M}{M^2}\right]$$

The term in the left square brackets is definitely negative as $\{\phi, \beta, \delta_g\} \in (0,1)$. Hence, the sign of the derivative is negative only if the following holds:

$$\beta^M(1-M\log\beta) < 1$$

As $\beta \in (0,1)$, the expression on the left is increasing in β. Further, the expression approaches to 1 as $\beta \to 1$. On the other hand, for $\beta \to 0$ one can apply the L'Hôpital's rule to get;

$$\lim_{\beta\to 0}\beta^M(1-M\log\beta) = 0.$$

Hence, we have that $\beta^M(1-M\log\beta) < 1$. Therefore $d\left(\bar{k}/y\right)/dM < 0$; that is, the steady state public capital to output ratio is higher, the lower is the completion duration. As the public capital is subject to positive but diminishing returns, it is implied that the level of public capital is decreasing in the completion duration as well. ■

Proof of Proposition 2

The household first order condition with respect to private capital holdings, k_t, can be written as below:

$$\lambda_t = \beta E_t\left[\lambda_{t+1}\left(q_{t+1}+1-\delta\right)\right] \tag{A8}$$

Where λ_t is the time t marginal utility of wealth, and q_t is the time t return on private

capital. The return on private capital is obtained from firm's problem as usual;

$$q_t = \alpha z_t k_{t-1}^{\alpha-1} n_t^{\alpha} \bar{k}_{t-1}^{\phi}. \tag{A9}$$

Plugging (A9) in (A8) and using the steady state version of the resulting equation, one can reach a definition for private capital to labor ratio:

$$\frac{k}{n} = \left(\bar{k}^{\phi} \frac{\alpha}{\frac{1}{\beta} - 1 + \delta} \right)^{\frac{1}{1-\alpha}}. \tag{A10}$$

The private capital to output ratio, on the other hand, can be written as follows using the production function;

$$\frac{y}{k} = \left(\frac{k}{n} \right)^{\alpha-1} \bar{k}^{\phi}. \tag{A11}$$

Plugging (A11) in (A10) yields the following equation:

$$\frac{k}{y} = \frac{\alpha}{\frac{1}{\beta} - 1 + \delta}.$$

Hence the private capital to output ratio is not affected by the fiscal side of the economy, hence the completion duration of public capital. ■

Proof of Proposition 3

The first order condition of the household's problem with respect to labor supply is given as below:

$$\xi \left(1 - n_t\right)^{-\chi} = \lambda_t w_t \tag{A12}$$

Above, ξ is a scale parameter, and χ is the parameter determining the Frisch elasticity in labor supply. The real wage rate in this economy is determined by the firm's problem:

$$w_t = (1 - \alpha) z_t k_{t-1}^{\alpha} n_t^{-\alpha} k_{t-1}^{\phi} \tag{A13}$$

The marginal utility of wealth is equal to the marginal utility of consumption in this model. Given the functional form for utility ordering, the marginal utility of wealth is

$$\lambda_t = c_t^{-\sigma}. \tag{A14}$$

Using the steady state versions of the equations (A12), (A13), (A14), the steady state versions of the economy-wide budget constraint, and the accumulation equations of private and public capital stocks together yield the following equation:

$$\xi (1-n)^{-\chi} = \left[\left(1 - \delta \frac{k}{y} - \delta_g \frac{\bar{k}}{y} \right) n \left(\frac{k}{n} \right)^{\alpha} \bar{k}^{\phi} \right]^{-\sigma} (1-\alpha) \left(\frac{k}{n} \right)^{\alpha} \bar{k}^{\phi} \tag{A15}$$

The definition for private capital to labor ratio given by the equation (A10) can be plugged in (A15) to get:

$$\xi (1-n)^{-\chi} = \left(1 - \delta \frac{k}{y} - \delta_g \frac{\bar{k}}{y} \right)^{-\sigma} n^{-\sigma} (1-\alpha) \left[\left(\bar{k}^{\phi} \frac{\alpha}{\frac{1}{\beta} - 1 + \delta} \right)^{\frac{\alpha}{1-\alpha}} \bar{k}^{\phi} \right]^{1-\sigma} \tag{A16}$$

As seen from equation (A16), the labor supply depends non-linearly on $\bar{k}$ and $\bar{k}/y$, both of which are decreasing in completion time. Hence, the impact of the completion duration of the public capital on labor supply is ambiguous in general. The only exception is when the coefficient of risk aversion is equal to 1, in which case the term in the square brackets vanishes and we end up with the equation below:

$$(1-n)^{-\chi} n = \frac{\left(1 - \delta \frac{k}{y} - \delta_g \frac{\bar{k}}{y} \right)^{-1} (1-\alpha)}{\xi} \tag{A17}$$

Let us take the derivative of both sides of equation (A17) with respect to M. As the public capital to output ratio is decreasing in M, the derivative of the right-hand-side is negative. Let us call this derivative as A. Now we have that;

$$(1-n)^{-\chi} \left(\frac{\chi n}{1-n} + 1 \right) \frac{dN}{dM} = A$$

The sign of dN/dM is negative only if the term below is positive:

$$\frac{\chi n}{1-n} > -1$$

The left-hand side of the inequality above is just the inverse of the Frisch elasticity of labor supply, which is positive. Hence we have that $dN/dM < 0$, that is, the labor supply is monotonically decreasing in the completion duration of public capital when the risk aversion is 1. ■

Proof of Proposition 4

The labor productivity is given as below:

$$\frac{y}{n} = \left(\frac{k}{n}\right)^{\alpha} \bar{k}^{\phi}. \tag{A18}$$

The private capital to output ratio is given by equation (A10). Using (A10) and rewriting (A18), we arrive at the following equation.

$$\frac{y}{n} = \left(\frac{\alpha}{\frac{1}{\beta} - 1 + \delta}\right)^{\frac{\alpha}{1-\alpha}} \bar{k}^{\frac{\phi}{1-\alpha}} \tag{A19}$$

In light of Corollary 1, equation (A19) implies that the average productivity is decreasing in completion time.■

Tables and Figures

Table 1: Key ratios

	$\bar{\imath}/y$ (%)	$\bar{k}/y$ (%)	c/y (%)	k/y
Argentina	2.2	36.6	76.9	2.3
Brazil	2.5	38.5	80.9	3.0
Bulgaria	2.5	50.9	86.8	1.1
Croatia	3.1	58.5	79.6	3.5
Egypt	4.3	55.9	93.3	0.9
India	6.3	78.5	77.3	2.3
Indonesia	2.9	31.2	65.0	2.4
Mexico	2.7	30.7	70.2	2.4
Morocco	4.4	51.8	79.8	2.7
Pakistan	4.0	66.6	88.3	1.4
Paraguay	4.6	63.9	73.1	2.2
Peru	4.2	58.6	75.7	2.2
Philippines	2.6	35.7	78.2	2.4
Romania	4.3	125.1	81.4	2.7
Russia	2.6	58.1	65.8	3.5
Serbia	1.9	24.2	93.3	4.4
Thailand	8.7	115.0	75.0	2.9
Turkey	3.3	59.5	78.5	2.0
Ukraine	2.0	68.9	82.3	5.5
Vietnam	7.1	46.1	72.1	1.6
Mean	3.8	57.7	78.7	2.6
Median	3.2	57.0	78.4	2.4

Note: $\bar{\imath}$: public investment, $\bar{k}$: public capital stock, y: output, k: total capital stock, c: total consumption. Public capital and public investment data are taken from IMF's ICSD database. Total consumption and output data are taken from World Bank's World Development Indicators. Capital output ratios are calculated using data from Penn World Tables 9.0. The figures are sample averages. The sample period varies by country.

Table 2. Stylized facts

Country	σ_y	$\rho_{y,y_{-1}}$	$\rho_{c,y}$	$\rho_{i,y}$	$\rho_{\bar{\imath},y}$	σ_c/σ_y	σ_i/σ_y	$\sigma_{\bar{\imath}}/\sigma_y$
Argentina	5.52	0.56	0.95	0.92	0.82	1.05	2.86	3.82
Brazil	3.44	0.57	0.71	0.93	0.49	0.77	2.51	5.16
Bulgaria	5.80	0.75	0.72	0.64	0.36	1.31	3.62	6.00
Croatia	3.83	0.68	0.96	0.87	0.36	0.96	3.01	5.34
Egypt	1.90	0.57	0.62	0.79	0.39	0.72	5.68	6.63
India	2.21	0.28	0.73	0.46	0.11	0.85	2.23	3.74
Indonesia	4.21	0.67	0.53	0.92	0.65	1.33	2.73	3.82
Mexico	3.16	0.57	0.73	0.83	0.66	1.51	3.44	7.31
Morocco	2.82	0.06	0.75	0.43	0.24	1.26	4.33	13.09
Pakistan	2.24	0.71	0.74	0.72	0.74	1.34	3.03	7.54
Paraguay	3.75	0.42	0.75	0.79	0.42	0.89	2.34	7.35
Peru	4.82	0.62	0.91	0.65	0.40	1.05	4.02	4.95
Philippines	3.17	0.69	0.90	0.87	0.56	0.59	3.98	5.89
Romania	5.83	0.51	0.95	0.83	0.72	1.12	2.88	3.49
Russia	7.15	0.72	0.73	0.98	0.70	0.69	2.33	4.15
Serbia	4.96	0.55	0.97	0.81	0.58	0.96	3.08	7.03
Thailand	3.89	0.74	0.88	0.95	0.49	0.92	3.87	4.37
Turkey	3.91	0.36	0.94	0.96	0.23	0.96	3.34	3.42
Ukraine	10.34	0.79	0.86	0.94	0.85	0.81	2.46	3.86
Vietnam	1.26	0.50	0.79	0.57	−0.15	1.92	4.57	9.60
Mean	4.21	0.57	0.81	0.79	0.48	1.05	3.32	5.83
Median	3.86	0.57	0.77	0.83	0.49	0.96	3.05	5.25

Note: σ_j: percentage standard deviation of variable j. $\rho_{j,j_{-1}}$: autocorrelation of variable j. $\rho_{j,y}$: correlation of variable j with output. c: consumption, i: investment, $\bar{\imath}$: public investment, y: output. The public investment data is taken from the IMF's ICSD database. All other data are taken from the World Bank's World Development Economics database.The sample period varies by country.

Table 3: Baseline Calibration

Parameter	Description	Value
α	Weight of the private capital stock	0.35
β	Discount factor	0.9502
μ	1-1/Elasticity of substitution, time-to-build function	0.5
$r_1....r_{10}$	Investment weights, slow economy	1/10
r_1, r_2, r_3	Investment weights, fast economy	1/3
δ	Depreciation of the private capital stock	0.12
δ_g	Depreciation of the public capital stock	0.07
ϕ	Coefficient of the public capital stock	0.09
σ	Coefficient of relative risk aversion	2
χ	Determines Frisch elasticity of labor supply	2
ξ	Utility function normalization parameter	9.9
η	Degree of overall externality	0
ρ	Persistence of the TFP process	0.48
v	Standard deviation of the exogenous shock	0.025

Note: Calibration target is the "average" emerging country. See Tables 1 and 2.

Table 4: Results; Mean Emerging Country

	λ^U (%)	λ^C (%)
Baseline calibration	1.528	0.137
$\eta = 0.10$	1.912	0.394
$\mu = 0.9$	1.524	0.135
$\mu = -3$	1.531	0.123
$\sigma = 1$	1.720	0.145
$\sigma = 1 \& \chi = 1$	1.756	0.147
$\sigma = 1 \& \chi = 0$	1.817	0.150
Front-loaded investment	2.023	0.209
Back-loaded investment	1.089	0.080
Pure gestation	4.703	0.770

Note: See Table 3 for the baseline calibration.

Table 5: First moments, baseline calibration

	M=10	M=3
c	0.206	0.209
$\bar{\imath}$	0.011	0.013
i	0.070	0.072
$\bar{k}$	0.166	0.201
k	0.577	0.590
n	0.250	0.249
q	0.175	0.175
w	0.748	0.767
y	0.288	0.294
c/y (%)	71.7	71.0
$\bar{\imath}/y$ (%)	3.8	4.5
$(\bar{\imath}+i)/y$ (%)	28.2	28.9
$\bar{k}/y$ (%)	57.8	68.4
$(\bar{k}+k)/y$	2.6	2.7

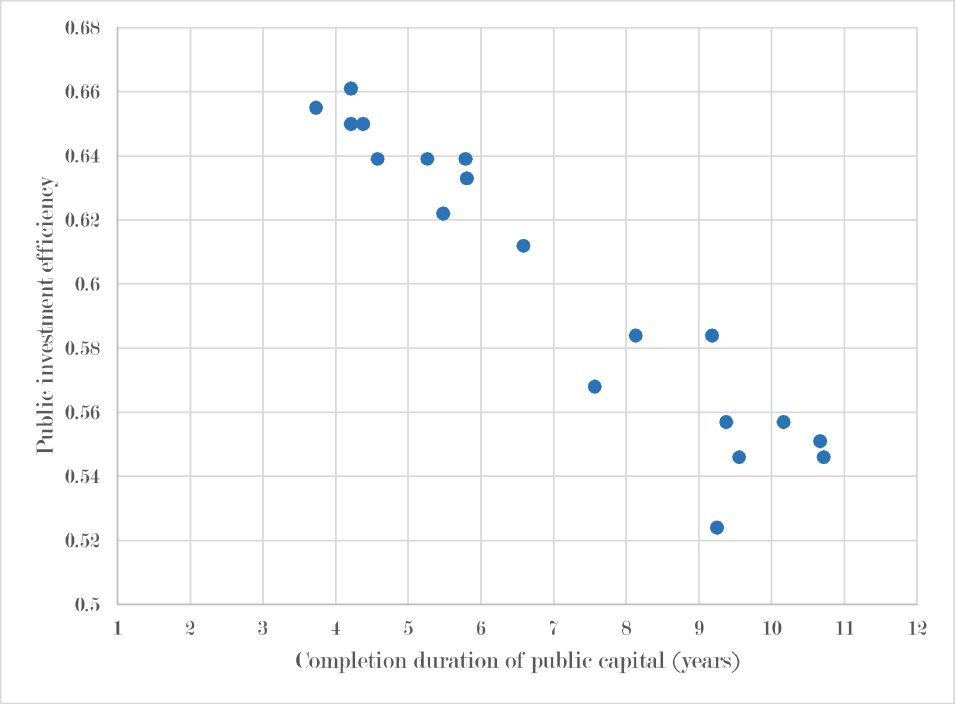
Note: c: consumption, $\bar{\imath}$: public investment, i: private investment, $\bar{k}$: public capital, k: private capital, n: labor effort, q: return on capital, w: return on labor, y: output. See Table 3 for the baseline calibration.

Table 6: Second moments, baseline calibration

	M=10		M=3	
Variable	σ_j	$\rho_{j,y}$	σ_j	$\rho_{j,y}$
c	1.92	0.80	1.94	0.79
$\bar{\imath}$	6.99	0.76	10.44	0.74
i	12.51	0.95	12.33	0.94
$\bar{k}$	3.01	0.15	3.73	0.29
k	4.18	0.75	4.07	0.76
n	1.55	0.45	1.60	0.45
q	4.39	0.53	4.29	0.55
w	3.78	0.93	3.82	0.93
y	4.21	1.00	4.27	1.00

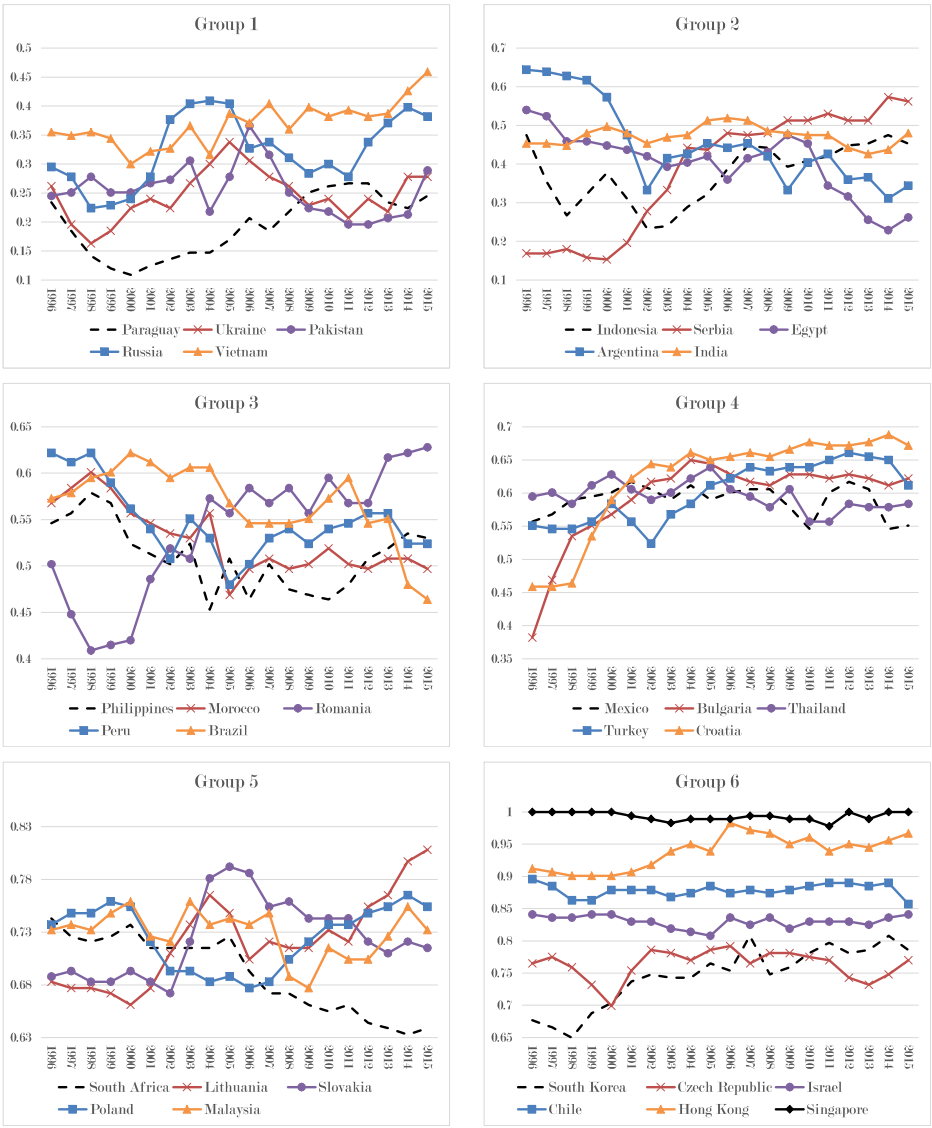
Note: σ_j: percentage standard deviation of variable j. $\rho_{j,y}$: correlation of variable j with output. $\rho_{j,j-1}$: autocorrelation of variable j. c: consumption, $\bar{\imath}$: public investment, i: private investment, $\bar{k}$: public capital, k: private capital, n: labor effort, q: return on capital, w: return on labor, y: output. See Table 3 for the baseline calibration.

Figure 1. The Turkish Experience



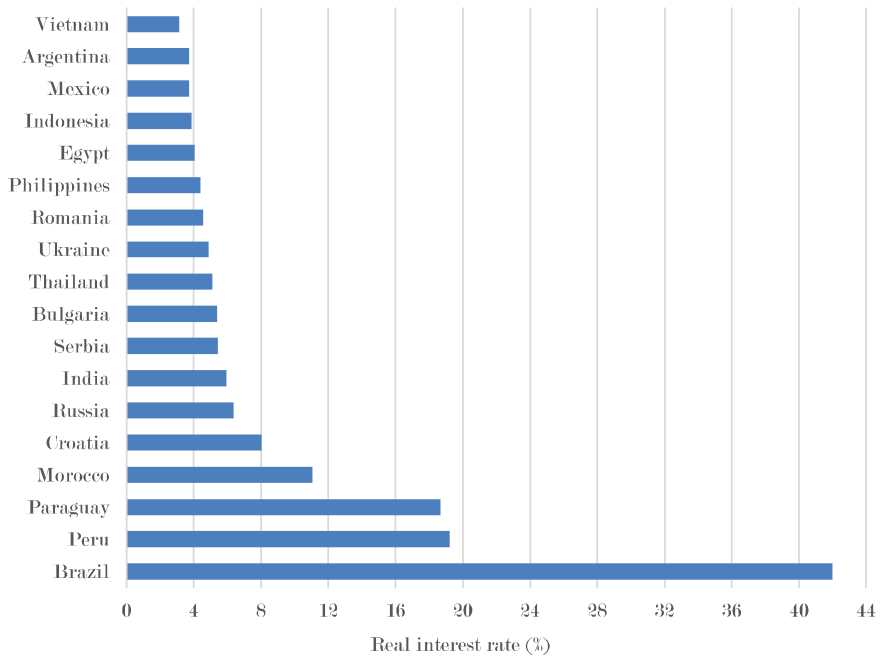
Note: The Public Investment Efficiency is proxied by the percentile ranking in the world with respect to the sum of the Control of Corruption, Regulatory Quality, and the Government Effectiveness indices under the Worldwide Governance Indicators of the World Bank. The Turkish Ministry of Development provides the data for the average completion duration of the public capital for Turkey.

Figure 2. Public Investment Efficiency



Note: Note: The Public Investment Efficiency is proxied by the percentile ranking in the world with respect to the sum of the Control of Corruption, Regulatory Quality, and the Government Effectiveness indices under the Worldwide Governance Indicators of the World Bank. The 31 emerging countries are divided into six groups according to their average percentile rank with respect to this proxy in the world within the period 1996-2015.

Figure 3. Real interest rate for the countries in the sample



Note: The real interest rate series are from the World Development Indicators of the World Bank. The averages are calculated for varying sample periods across countries. The periods of high and volatile inflation are omitted. For most of the countries, the sample period is started around the mid-1990s, when the inflation rates are more or less stabilized.

Figure 4. Comparative statics: Steady-state values along increasing completion duration, M

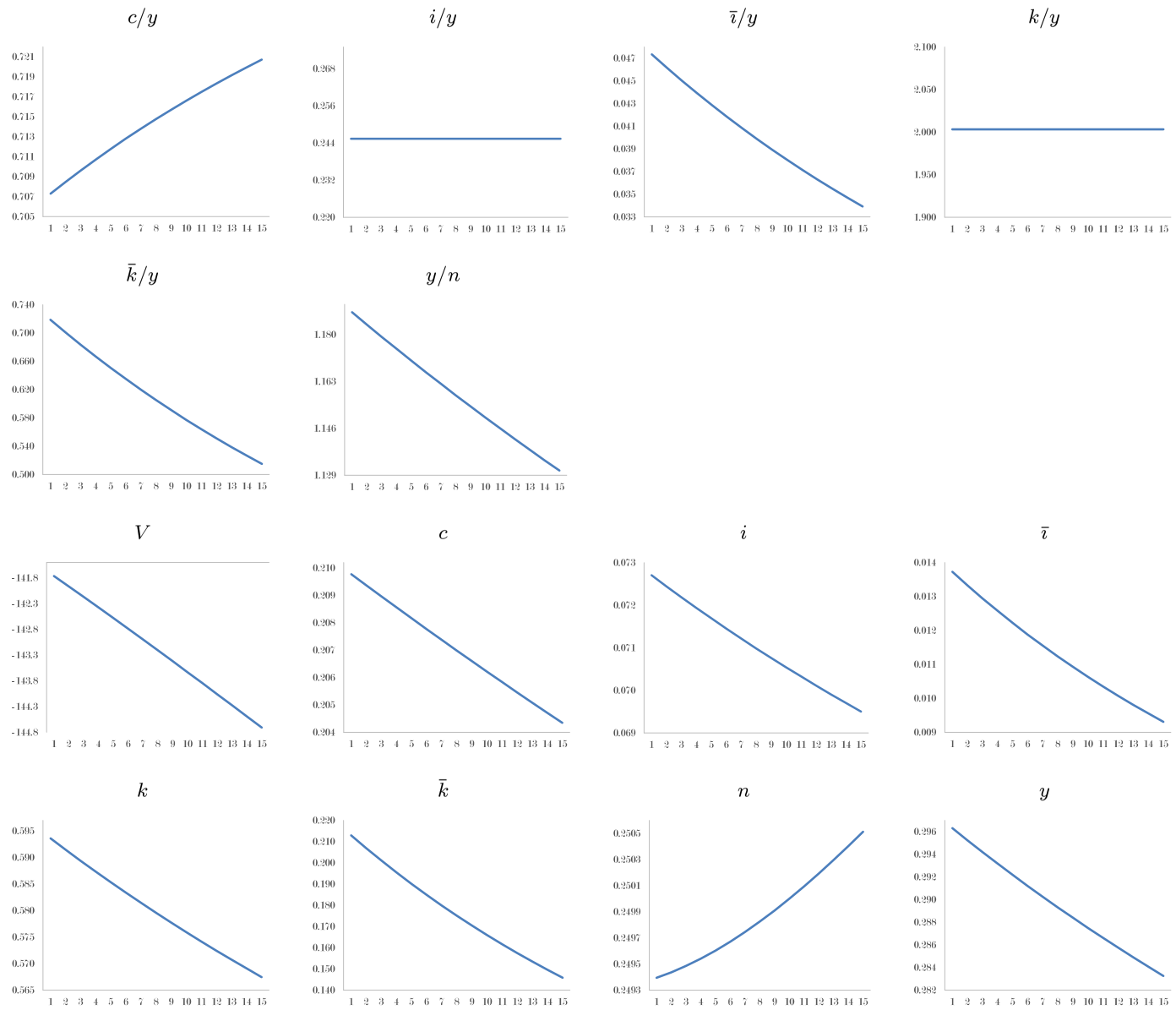


Figure 5. Transition after the reform

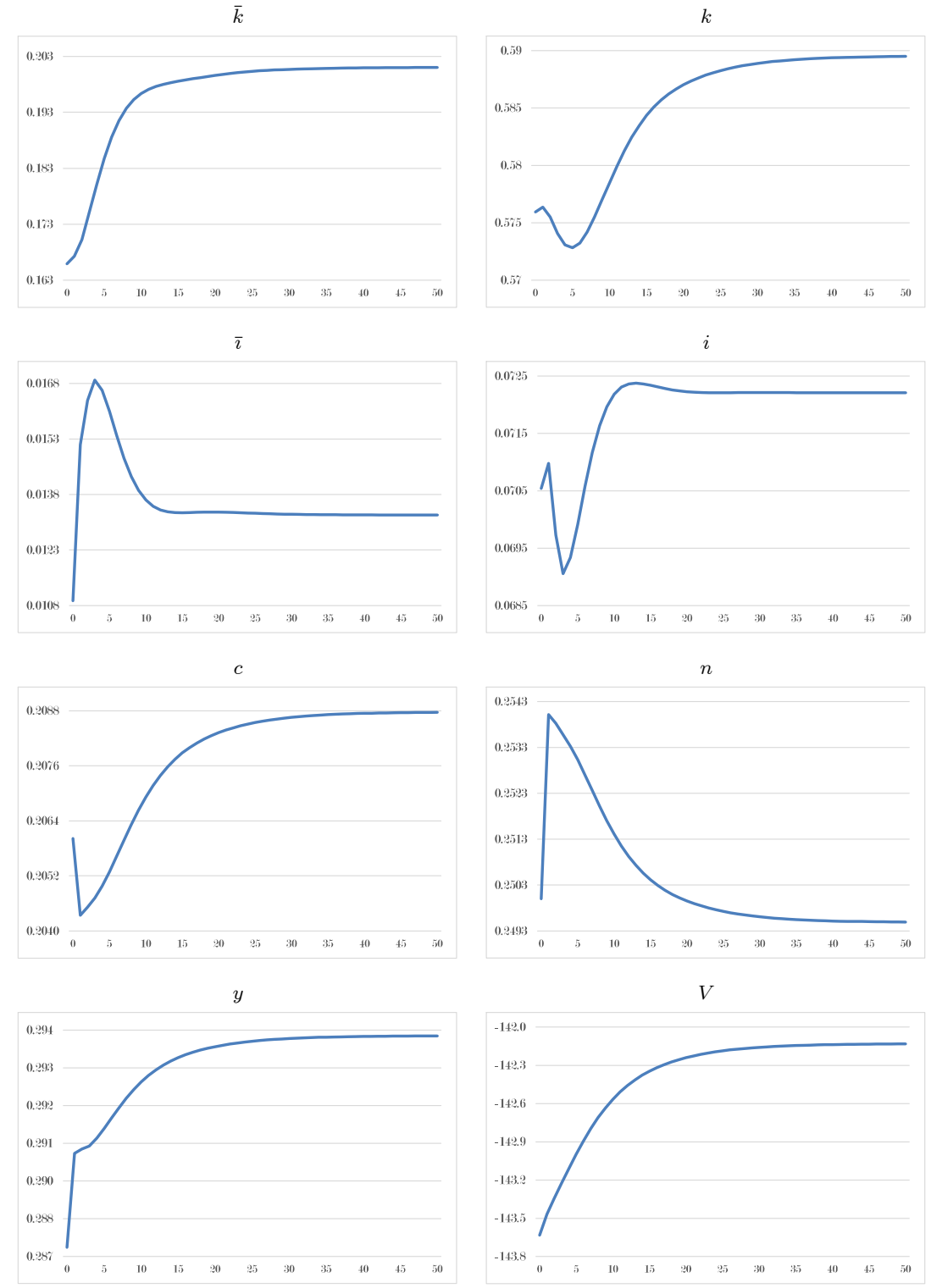
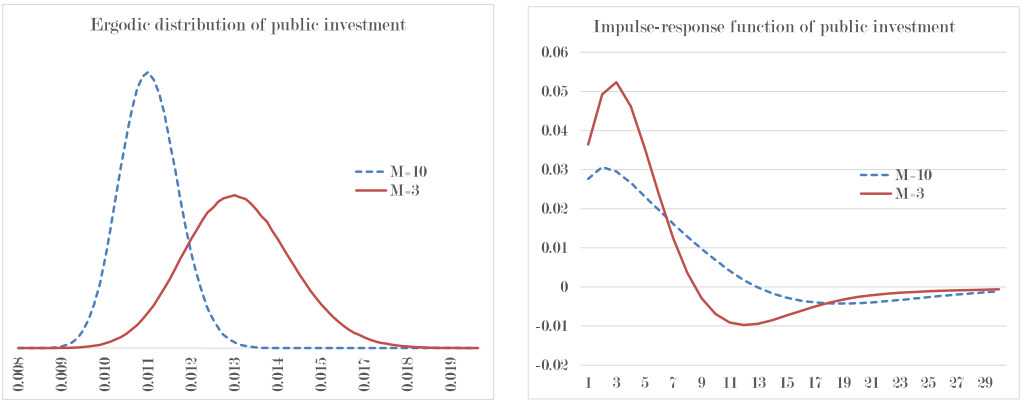
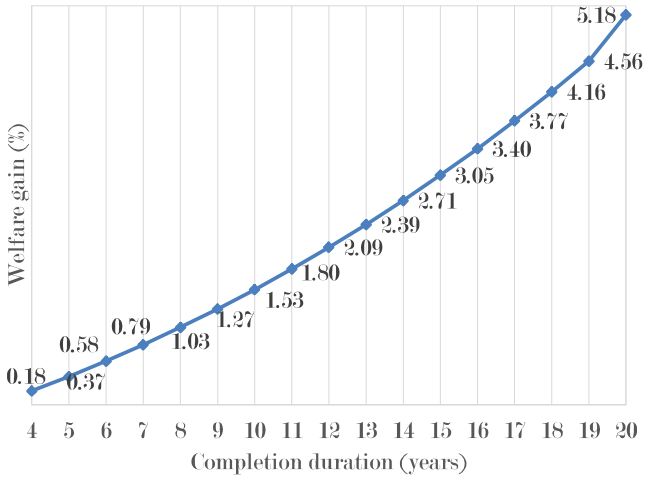


Figure 6. Public investment under short and long completion duration



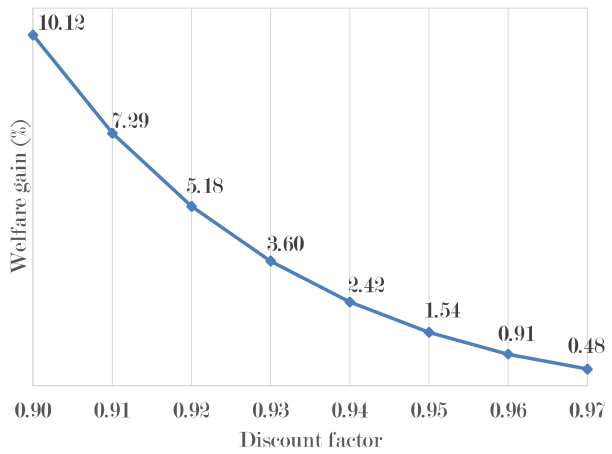
Note: Ergodic distribution is inferred from a one-million periods simulation under the long (M=10) and short (M=3) completion duration. The impulse response functions are with respect to a one standard deviation productivity shock.

Figure 7. Welfare gain and the longevity of completion duration



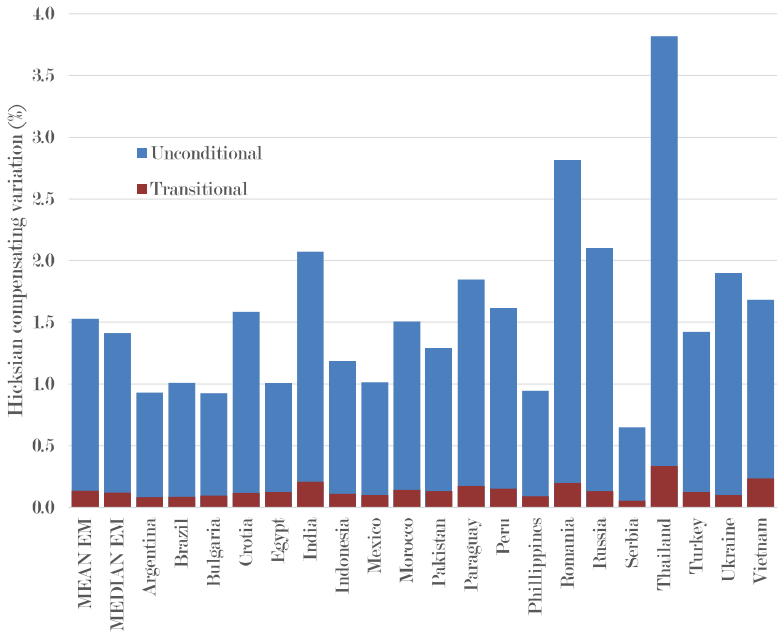
Note: The welfare gain from reducing the completion duration of the public capital to 3 years from $M = 4, ..., 20$ years.-

Figure 8. The effect of discount factor



Note: The parameters α and ϕ are adjusted so that the steady-state ratios of macro aggregates remain the same as the baseline case across varying degrees of impatience. All other key parameters are kept constant.

Figure 9: Welfare impact of the reform, all countries



Note: Figures represent the unconditional welfare gains of a reform that reduces the completion duration of public capital stock from 10 to 3 years. The gains are measured as Hicksian Compensating Variations in percentage terms. The blue bars represent the unconditional welfare impact of the reform. The red bars represent the transitional welfare impact, that is when the welfare in each regime is conditioned on the distribution of the state vector in the pre-reform economy.

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