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# Optimal public debt redux[☆]

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ABSTRACT

We examine the role played by government investment in infrastructure in determining the optimal quantity of public debt in a heterogeneous agent economy with incomplete insurance markets. Calibrating our model to the key aggregate and distributional moments of the U.S. economy for the period 1990–2015, we show that (i) the inclusion of infrastructure, and (ii) transitional dynamics between stationary states critically affect the characterization of the optimal level of public debt. Our results indicate that the inclusion of public infrastructure in the model specification implies a lower optimal debt level relative to the specification without infrastructure, both when comparing stationary equilibria and when accounting for transitional dynamics. When welfare comparisons are made by comparing stationary equilibria, we find that it is optimal for the government to accumulate assets (public surplus). However, once transitional dynamics are accounted for, accumulating debt becomes optimal, with the optimal share implied by our model being significantly higher than the average public debt-GDP ratio for the U.S. observed during our sample period.

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## 1. Introduction

What is the optimal amount of public debt? This important question has received a lot of attention recently, especially in the aftermath of the global financial crisis of 2008–2009. In a traditional representative agent model, the quantity of public debt is irrelevant for private decision making as long as the intertemporal budget constraint of the government satisfies the transversality condition (thereby ensuring that the government does not run a Ponzi scheme against the private sector). However, in a context where households receive idiosyncratic shocks that cannot be perfectly insured, public debt can have important consequences for agents' decisions. Higher levels of public debt can be detrimental to welfare by crowding out private investment, leading to lower wages, output and consumption in equilibrium. At the same time, public debt can also relax borrowing constraints for households by increasing liquidity in the economy, thereby facilitating consumption smoothing and improving aggregate welfare. *A priori*, it is therefore not clear whether it is optimal for the government to

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accumulate debt or assets (surplus) in equilibrium. This paper analyzes this important public policy question by embedding two key features in a calibrated heterogeneous agent framework: (i) the government's provision of productive public goods such as infrastructure, and (ii) transitional dynamics of the economy when the government's debt policy changes. Both of these features have not been analyzed systematically in the existing literature and, as we will subsequently demonstrate, fundamentally alter the characterization of the optimal level of public debt.

In their seminal paper studying public debt in the United States, Aiyagari and McGrattan (1998) show that the optimal level of debt is positive and approximately two-thirds of GDP which, in fact, was very close to the actual share of public debt in the United States during the post-war period. Additionally, they find that the welfare profile is relatively flat near the optimum, suggesting small welfare losses from deviating from this level. Three critical issues that (Aiyagari and McGrattan, 1998) abstracted from are: (i) matching the wealth and earnings distribution for U.S. households, (ii) accounting for transitional dynamics when computing the welfare effects associated with a change in debt policy, and (iii) accounting for the composition of government spending, specifically on productive public goods such as infrastructure. Using a labor productivity shock process that generates endogenous income and wealth distributions that more closely match the U.S. data, Rohrs and Winter (2017) find that the optimal level of public debt is actually a surplus when welfare effects are computed by comparing stationary equilibria. On the other hand, Desbonnet and Weitzenblum (2012) find that once the transition path is accounted for, there may exist significant welfare gains from increasing the level of public debt, though they do not characterize what the new optimum should be.[1] Furthermore, much of the existing literature on optimal public debt has only taken into account government consumption and transfers when characterizing government spending. Both of these components are modeled as being wasteful, with no consequences for the economy's productive capacity. By contrast, public infrastructure, as embodied in an economy's stock of roads, transportation networks, ports, power and electricity generation, etc., has important consequences for the productivity of private factors such as capital and labor.[2] These productivity effects are especially important in models where agents face idiosyncratic shocks and lack access to complete insurance markets, as changes in factor prices distort savings, consumption, and labor supply decisions, thereby affecting aggregate welfare. Moreover, since the benefits of government investment in infrastructure for private factors of production accrue only gradually over time (as its stock accumulates), its consequences for the optimal level of public debt cannot be correctly analyzed unless the transition path between steady states is considered.

The primary contribution of our paper is two-fold. First, we show that the introduction of public infrastructure into the aggregate production structure of a heterogeneous agent economy calibrated to be consistent with U.S. wealth and earnings inequality fundamentally alters the calculation of the optimal quantity of public debt. Second, we show that there are stark differences between the short-run and long-run welfare consequences of a change in a country's debt policy, which in turn leads to dramatically different conclusions for the optimal share of public debt once the transition path between stationary states is internalized. These issues have not been addressed simultaneously in the existing literature on optimal public debt.

The starting point of our analysis is the development of two distinct model environments: a standard environment where output is produced using only private capital and labor, and an alternative environment where we introduce a government-provided stock of public infrastructure which enters the aggregate production function and generates positive spillovers for private capital and labor. Both model specifications are calibrated to generate the same stationary equilibrium and replicate key aggregate and distributional characteristics of the U.S. economy for the sample period 1990–2015. While we do not target the debt-GDP ratio when calibrating the baseline stationary equilibrium, we follow the existing literature and adjust the debt-GDP ratio exogenously when computing counter-factual stationary equilibria that would result under alternative debt policies (see Aiyagari and McGrattan, 1998, among others). Also following the previous literature, the government adjusts the income tax rate to maintain their budget constraint as debt is varied exogenously.

With the baseline and counterfactual stationary equilibria pinned down for both model specifications, we proceed by computing the welfare impact of moving from the baseline equilibrium to each of the counterfactual equilibria. We find that the optimal share of public debt is a surplus when welfare is computed by comparing stationary equilibria. Specifically, the implied welfare-maximizing level of public debt in the model specification with infrastructure is a surplus of about 175% of GDP. On the other hand, the specification without public infrastructure implies a much smaller surplus, at about 75% of GDP. Not only is the optimal surplus substantially larger when infrastructure is included, but the welfare effects around the optimum are also sizeable, relative to the specification without infrastructure.

One caveat to the above result is that this calculation of the optimal level of public debt (or surplus) incorporates only the *long-run* welfare change between stationary equilibria. In other words, the underlying assumption is that any change in the level of debt is accompanied by an instantaneous "switch" to the new stationary equilibrium. While an understanding of these long run costs and benefits of increasing or reducing public debt is no doubt important, it is implausible to assume that the economy adjusts instantaneously to its new long-run equilibrium. In fact, a change in debt policy will lead to a

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[1] See Floden (2001) and Peterman and Sager (2016) for an assessment of the role of optimal transfers and life-cycle effects on optimal debt, respectively. There are also a few recent papers that examine optimal tax policy that relate to this literature (see Acikgoz, 2013; Bakis et al., 2015; Dyrda and Pedroni, 2016). However, unlike our work, these papers do not consider the simultaneous inclusion of public infrastructure and transitional dynamics when computing welfare effects in a model that is calibrated to replicate the degree of inequality in the U.S.

[2] There is a large literature that investigates the growth-enhancing feature of public infrastructure (Aschauer, 1989; Barro, 1990; Glomm and Ravikumar, 1994). The distributional effects of infrastructure investment have also been studied more recently (Chatterjee and Turnovsky, 2012; Gibson and Rioja, 2017a,b).

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