

The Risk of Sub-Optimal Allocation of Government Spending When Implementing GDP-Linked Bonds

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Abstract: This paper examines the risk of suboptimal allocation of public resources in countries issuing GDP-linked bonds and how such risk can be mitigated. Throughout the analysis, a linear interest rate function for GDP-linked bonds is used. The paper shows that converting some share of the national debt to GDP-linked bonds makes growth above the expected growth trend relatively more costly compared to countries having solely plain vanilla bonds. Using this insight we develop a model of allocation of public resources where governments are faced with a trade-off between productive and unproductive spending. Applying the model, we find that introducing GDP-linked bonds should lead to a reallocation of public resources, in favour of more unproductive spending. As investors are unable to fully observe, verify and control governmental behavior in the post-contract period and as incentives are not necessarily aligned, there is a risk of moral hazard related to GDP-linked bonds. The paper further discusses ways to mitigate the moral hazard risk and propose increased transparency and monitoring to be viable ways forward.

Keywords: GDP-linked Bonds, Moral Hazard, Sovereign Debt, Public Spending

JEL: H63, D82, E62

Supervisor:	Karl Wärneryd
Date submitted:	May 17, 2021
Date examined:	June 1, 2021
Discussants:	Erik Ekelund and Simon Engdahl
Examiner:	Johanna Wallenius

Acknowledgements

We would like to thank our supervisors Karl Wärneryd and Adrien d'Avernas at the Stockholm School of Economics for their support during the process of writing the thesis. We would also like to express our gratitude to Mona Stenmark and Tore Ellingsen for their valuable insights along the way.

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1. Introduction and purpose

A combination of decreasing revenues and large pandemic relief packages have increased the global debt by 24 trillion dollars since 2019. In the end of 2020, the global debt was 281 trillion dollars, exceeding Global GDP with 355%.¹ The rising debt levels are concerning and the risk of debt crises and default needs to be minimized. In the aftermath of the Latin American debt crises in the 1980s, the concept of linking debt repayments to performance was brought forward as a debt-management instrument². GDP-linked bonds is a bond with payments linked to the GDP in the country. This means payments are low in recessions and high in booms, resulting in a decreased risk of debt crisis and default. However, the instrument has not yet been issued by any country and there are issues to overcome before making reality of GDP-linked bonds. One of them is the risk of suboptimal fiscal policies, which can pose a moral hazard problem for investors. Actions in the post contract period are non-contractible and non-verifiable, meaning investors are unable to control governments behavior ex post. As interest rate costs increase as a function of growth after implementing GDP-linked bonds, government incentives are not guaranteed to be aligned with investors.³ This paper aims to investigate this moral hazard problem. A theoretical analysis will be carried out by constructing a model of government spending after implementing GDP-linked bonds, compared to having plain vanilla bonds. With the research question “Does GDP-linked bonds come with a risk of suboptimal allocation of public resources? If so, how can it be mitigated?”, this paper finds that issuing GDP-linked bonds should lead to a reallocation of public resources in favour of unproductive spending.

¹Maki, Sydney. 'World's \$281 Trillion Debt Pile Is Set to Rise Again in 2021' in Bloomberg.com <https://www.bloomberg.com/news/articles/2021-02-17/global-debt-hits-all-time-high-as-pandemic-boosts-spending-need> [accessed: 25/04/2021]

²Shiller, Robert J. 'Macro Markets : Creating Institutions for Managing Society's Largest Economic Risks', *Oxford University Press*, (1993).

³Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

2. Theoretical background

This section walks through the concept of GDP-linked bonds, its advantages and its obstacles. The purpose is to make it easier to understand the workings of GDP-linked securities and thereby the theoretical analysis presented below.

2.1. *The concept of GDP-linked bonds*

GDP-linked bonds have never yet been implemented. Therefore there is no example of exactly how the bonds function with regards to interest rate, maturity and other design choices. Multiple papers have been published, discussing different proposals of design, however consensus have not yet been reached^{4 5}. Although the details are still under discussion, the concept is clear and works like the following. The government issues bonds with repayments linked to the fluctuations of the GDP of the country, which means payments are high in booms and low in recessions.

2.2. *Advantages*

Issuing GDP-linked debt is associated with multiple benefits, both for the issuing country and its investor. Firstly, the counter cyclical characteristics implies a lower debt burden in times when the economy is weak. This has a stabilizing effect on the volatility of the debt-to-GDP ratio and reduces the risk of a debt crisis and default.⁶ Debt crises and defaults are known to be costly and harmful for both the country and its investors. For example, from the country's point of view, it tends to result in unemployment, capital flight, renegotiation/litigation. The same can be said for investors, who risk not getting paid and having to face increased costs of renegotiation/litigation.⁷

⁴ Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

⁵ Kamstra, Mark, and Shiller, Robert J. 'The Case for Trills: Giving Canadians and their Pension Funds a Stake in the Wealth of the Nation', *Commentary - C.D.Howe Institute*, no. 271, (2008), pp. COV.

⁶ Kim, Jun I. and, Ostry, Jonathan D. 'Boosting Fiscal Space : The Roles of GDP-Linked Debt and Longer Maturities', *International Monetary Fund*, (2018).

⁷ Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

Another advantage is that GDP-linked bonds have the potential to increase fiscal space.⁸ As interest rate payments decrease in times of recession, the country is left with larger means to stimulate the economy. It can also have positive effects on overspending in good times.⁹ It has also been argued that the introduction of GDP-linked debt may enable countries to take on larger debt to GDP-ratios, as their ability to pay interest increases.¹⁰

There are also several identified benefits from the perspective of investors. Firstly GDP-linked bonds are a way for investors to diversify portfolios and have the potential to decrease the volatility of returns, especially if issued in several countries. Furthermore, it gives investors a chance to benefit from the development of an entire country and its policies, rather than only from the businesses within the country. In line with this, the concept of GDP-linked bonds has been described as having features making it similar to having equity in a country.^{11 12}

2.3. *Issues to overcome*

As noted, no GDP-linked debt has yet been issued. Even though there is potential in the instrument, there are still a number of issues to overcome before making reality of GDP-linked bonds.

The first set of problems is associated with the fact that the instrument is new. For example, investors are expected to demand a high novelty premium to cover the additional research required to analyse and price the new instrument. Additionally, there are still insecurities about design and

⁸ Kim, Jun I., and Ostry, Jonathan D. 'Boosting Fiscal Space : The Roles of GDP-Linked Debt and Longer Maturities', *International Monetary Fund*, (2018).

⁹ Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

¹⁰ Kim, Jun I., and Ostry, Jonathan D. 'Boosting Fiscal Space : The Roles of GDP-Linked Debt and Longer Maturities', *International Monetary Fund*, (2018).

¹¹ Shiller, Robert J. 'Macro Markets : Creating Institutions for Managing Society's Largest Economic Risks', *Oxford University Press*, (1993).

¹² Shiller, Robert J. 'The New Financial Order : Risk in the 21st Century', *Princeton, N.J, Princeton University Press*, (2003).

practical functioning, making it hard for investors to build adequate models for analysis. In addition liquidity has been brought forward as a problem, at least in the initial stages.¹³

Furthermore, there are multiple issues related to incentives. Several moral hazard-related concerns have been brought forward, for example the risk of incentives to manipulate or falsify data. Problems of adverse selection have also been presented and there is a concern that there will be an overrepresentation of countries with poor economic prospects issuing GDP-linked bonds.¹⁴

2.4. *Moral Hazard*

Since this paper evaluates the moral hazard risk of GDP-linked bonds, a definition of how the term will be used is needed. When the term moral hazard is used, it refers to a situation where one party is unable to observe, and hence control, the other party's behavior after the contract has entered into force¹⁵. In the setting of GDP-linked bonds contracts, this means the investors are unable to observe, control and verify the policies implemented by the state ex post. It is expected by investors that the government will maximize the utility of the country after issuing the bonds. If incentives are not aligned between investors and the state in the ex post period, there is a risk of moral hazard.

3. Literature review

3.1. *Literature on GDP-linked bond from a general perspective*

After the debt crisis in the 1980s, the idea of linking repayment of debt to the country's ability to pay was brought up. Initially the idea of linking repayments to GDP was rejected. Instead it was suggested to link repayment to factors outside the country's control. Krugman was one of the first

¹³ IMF. 'State-contingent Debt Instruments for Sovereigns', *IMF Policy Paper*, (2017)
<https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/05/19/pp032317state-contingent-debt-instruments-for-sovereigns> [accessed: 27/01/2021]

¹⁴ IMF. 'State-contingent Debt Instruments for Sovereigns', *IMF Policy Paper*, (2017)
<https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/05/19/pp032317state-contingent-debt-instruments-for-sovereigns> [accessed: 27/01/2021]

¹⁵ Goolsbee, Austan, Syverson, Chad, and Levitt, Steven D. 'Microeconomics', 2nd edn, W.H. Freeman & Co Ltd, (2016). p.617

to suggest indexing payments to “the state of nature”¹⁶. Froot, Scharfstein and Stein investigated the potential of indexing debt payments to variables outside of the country’s control, mainly because of the negative moral hazard effects of linking debt forgiveness to output.¹⁷

Shiller was the first to propose issuing GDP-linked securities. In his original version he indexed both the coupon and the principal to the level of nominal GDP. The securities were presented as perpetual claims on part of a country’s GDP. Shiller argued that the security is similar to equity in companies, as the security would pay based on the performance of the country.¹⁸

Kamstra and Shiller develop the argument made by Shiller by encouraging the Canadian Government to issue a new debt instrument, called a “Trill”. The idea is a security with coupon payments equal to one trillionth of the country’s GDP. The authors perform a valuation on their proposed security using CAPM and conclude that the yield would be attractive for the government. They also find that it would be beneficial for private and public pension funds, private investors and institutional investors, mostly because of its potential to diversify portfolios.¹⁹

In “The Case for GDP-Indexed Bonds”, Borensztein and Mauro propose that countries should issue GDP-linked bonds indexed to the real growth rate of GDP, to insure the country against possible slowdowns in growth. Borensztein and Mauro²⁰ propose that “it simply requires introducing an indexation clause in otherwise standard sovereign bonds”. The paper argues that the following advantages for the issuing country are accompanied with GDP-linked bonds. The reduced likelihood of debt crisis, reduced debt to GDP ratio volatility, reduced need for implementing procyclical fiscal policies, more stable tax rates, reduced ability for extreme spending.

¹⁶ Krugman, Paul. 'Financing Vs. Forgiving a Debt Overhang', *Journal of Development Economics*, vol. 29/no. 3, (1988), pp. 253-268.

¹⁷ Froot, Kenneth A., Scharfstein, David S., and Stein, Jeremy C. 'LDC Debt: Forgiveness, Indexation, and Investment Incentives', *The Journal of Finance (New York)*, vol. 44/no. 5, (1989), pp. 1335-1350.

¹⁸ Shiller, Robert J, 'Macro Markets : Creating Institutions for Managing Society’s Largest Economic Risks', *Oxford, University Press*, (1993)

¹⁹ Kamstra, Mark, and Shiller, Robert J. 'The Case for Trills: Giving Canadians and their Pension Funds a Stake in the Wealth of the Nation', *Commentary - C.D.Howe Institute*, no. 271, (2008), pp. COV.

²⁰ Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

There are potential upsides for international investors as well. Borensztein and Mauro state the following. The possibility to invest in an asset that is linked to another country's GDP, low insurance premium on the GDP-linked bonds, a lower frequency of formal default, and the possibility to take a position on a countries' future growth prospects. The authors also identified uncertainties and problems needed to overcome before implementing GDP-linked bonds. Primarily they found the tradeoff between insurance and moral hazard, the verifiability of GDP data, and lastly, the demand for liquidity in the market to be the most important ones. Using CAPM the authors estimate that the risk premium can be expected to be small due to the low degree of cross-country co-movement of GDP growth rates. This implies that investors who hold a diversified portfolio of GDP-linked bonds can, to a large extent, eliminate the risk of GDP growth.²¹

3.2. *Literature on moral hazard in GDP-linked bonds*

Borensztein and Mauro are the ones who most thoroughly analyse moral hazard and government policies with regards to GDP-linked bonds. They state that there is a risk of governments implementing sub-optimal policies when having GDP-linked debt. However, they argue that the key question is not if moral hazard exists, but if it is larger than for plain vanilla bonds. They also state that governments with the possibility to credibly commit to growth enhancing policies will be in a more appealing position to issue GDP-linked bonds. This applies for governments in, for example, International Monetary Fund (IMF)-supported programs or governments in a system of fiscal rules and peer monitoring. Furthermore, they argue that the country's growth rate is determined by the decision of individual businesses which are too small to take the government debt into account.²² Besides Borensztein and Mauro, the following authors discuss the moral hazard issue, although without thoroughly analysing its scope or mechanisms, e.g. Griffith-Jones

²¹Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

²²Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216..

and Sharma²³, Carnot and Pamies Sumner²⁴, Schröder et al.²⁵ and the IMF²⁶. These papers argue that the moral hazard risk is exaggerated and doubt that politicians would limit growth, much because only a fraction of debt will be GDP-linked.

4. Contribution to literature

As presented in the literature review, the issue of moral hazard with regards to growth policy has been touched upon but never fully analysed in the previous work. This paper attempts to shed light on the issue by making a more thorough analysis of the incentives of government officials and its underlying mechanisms. The contribution of the paper lies mainly in the theoretical analysis of the moral hazard risk, which will then be followed up by a discussion based analysis of potential ways to mitigate the moral hazard effect. It is worthy to note that the emphasis lies on the theoretical risk. The theoretical risk is not necessarily corresponding to the practical risk, which is why a discussion about practical application will be covered by the end.

4.1. Research question

Does GDP-linked bonds come with a risk of suboptimal allocation of public resources? If so, how can it be mitigated?

5. Analysis including results

As GDP-linked bonds have never yet been implemented, there is no data available and the analysis will be carried out theoretically. Hence, this section is a theoretical analysis of the implementation of GDP-linked bonds' potential impact on allocation of government spending.

²³ Griffith-Jones, Stephany, and Sharma, Krishnan. 'GDP-Indexed Bonds: Making It Happen', *DESA working paper*, no.21 (2006).

²⁴ Carnot, Nicolas, and Pamies Sumner, Stéphanie. 'GDP-linked Bonds: Some Simulations on EU Countries' *European Commission Working Paper* 073, (2017).

²⁵ Schröder, Michael, Heinemann, Friedrich, Kruse, Susanne, and et al. 'Pay High in Good Times, Pay Low in Bad Times', *Journal of International Development*, vol. 19/no. 5, (2007), pp. 667-683.

²⁶ IMF. 'State-contingent Debt Instruments for Sovereigns', *IMF Policy Paper*, (2017)

<https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/05/19/pp032317state-contingent-debt-instruments-for-sovereigns> [accessed: 27/01/2021]

Before evaluating the connection to allocation of government spending, the relationship between government spending and GDP-growth must be established. Previous papers on GDP-linked bonds have argued that this relationship is weak. For example, Borensztein and Mauro writes that GDP-growth is determined by decisions of individual firms, which are too small to take government debt payments into account²⁷. It is most likely true that individual firms do not consider government debt payments when making decisions about for example production levels. However, the statement neglects the possibility of governments making policies and spending money in a way that impacts the decisions made by individual firms and consumers, and thereby the economic growth.

The literature on the relationship between government spending and its impact on growth is diverse, and the conclusions vary depending on the theoretical springboard. For example, Barro finds that there exists a certain level of government spending which optimizes GDP-growth and that this relationship is non-linear.²⁸ Another example is the research from Furceri and Zdzienicka, who, by analysing data from the Organisation for Economic Co-operation and Development (OECD), finds that increased government social spending results in an increase in economic activity²⁹. The same is found by Zagler and Dürnecker when evaluating government spending on education and infrastructure³⁰. These results all point to a positive relationship between government spending and GDP-growth. However there are also contradicting studies. E.g, Landau find that an increase in government consumption spending has negative effect on GDP-growth³¹. Although different types of government spending seem to have varying effects on GDP-growth and that there are conflicting results regarding its magnitude, it is clear that governments have the possibility to impact growth by adapting spending and fiscal policy.

²⁷Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

²⁸Barro, Robert J. 'Government Spending in a Simple Model of Endogenous Growth', *The Journal of Political Economy*, vol. 98/no. 5, (1990), pp. S103-S125.

²⁹Furceri, Davide, and Zdzienicka, Aleksandra. 'The Effects of Social Spending on Economic Activity: Empirical Evidence from a Panel of OECD Countries', *Fiscal Studies*, vol. 33/no. 1, (2012), pp. 129-152.

³⁰Zagler, Martin, and Dürnecker, Georg. 'Fiscal Policy and Economic Growth', *Journal of Economic Surveys*, vol. 17/no. 3, (2003), pp. 397-418.

³¹Landau, Daniel. 'Government Expenditure and Economic Growth: A Cross-Country Study', *Southern Economic Journal*, vol. 49/no. 3, (1983), pp. 783-792.

After settling that governments actually have the possibility to impact growth, the next step is to evaluate if the introduction of GDP-linked bonds into the country's debt structure will have an impact on government officials' incentive to maximize growth. This will be done in two separate sections building on each other. The aim of the first section is to establish how the introduction of GDP-linked bonds affect the benefits of growth from the government's point of view. The aim of the second section is to analyze what the change in benefits from growth implicates for government officials incentives when allocating public resources.

5.1. *GDP-linked bonds impact on the benefits of growth*

To be able to evaluate the benefits of growth when introducing GDP-linked debt, it is necessary to introduce some assumptions. The first assumption is that the size of the total national debt will be unaffected, meaning it is assumed that the country will convert some share of its existing debt to GDP-linked bonds. Based on this assumption it is possible to compare and evaluate how benefits from growth change after implementing GDP-linked bonds.

In the paper “The case for GDP-indexed bonds”, Borensztein and Mauro propose to use a contract with a linear interest rate function when introducing GDP-linked bonds into the market. More precisely, they propose that the interest rate will depend on the deviation from the trend in GDP growth in the issuing country. For example, if a country has a trend in GDP growth of 3 percent, and has a growth rate of 5 percent in a particular year, then the interest rate they would have to pay that same year would be 2 percent larger than the one of the country's plain vanilla bonds. This means if the interest rate of plain vanilla bonds is 4 percent annually, the total interest rate for GDP-linked bonds would be 6 percent. Formally this can be expressed in the following way.³²

$$r_{GDPlinked} = r_{plain\ vanilla} + deviation\ from\ trend \quad (1)$$

³²Borensztein, Eduardo, and Mauro, Paolo. 'The Case for GDP-Indexed Bonds', *Economic Policy*, vol. 19/no. 38, (2004), pp. 166-216.

The following analysis will be made based on the interest rate function proposed by Borensztein and Mauro. Their design proposal is the simplest one in the previous literature and hence suitable for demonstrating the effects of GDP-linked bonds. The function is also widely referred to in previous work.

To compare how benefits from growth will be affected, a model of the economy in the country will be introduced. The model is kept deeply simplified in order to isolate the factors affected by the introduction of GDP-linked bonds. The intention is to compare how much of the surplus the government will be able to dispose of based on the choice of financing.

Firstly, the revenue side of the model of the governmental balance sheet will be considered for the case when the state has converted some share of its debt to GDP-linked bonds. For simplicity, it is assumed that the government receives a constant share of the growth in taxes. The share is called τ in the following analysis. This means that for all incremental growth the state receives,

$$\tau \times (GDP_{t-1} \times q_t) \quad (2)$$

where GDP_{t-1} is the base level of GDP at time $t - 1$ and q_t is the growth rate for the period.

Secondly, the cost side will be considered for the case with GDP-linked bonds, it consists of the components shown in equation (3).

$$D_{GDPlinked} \times (r + (q_t - \mu)) \quad (3)$$

Where $D_{GDPlinked}$ is the total debt in GDP-linked bonds, r is the interest rate on plain vanilla bonds and μ is the growth trend. Hence, the governmental surplus/deficit from GDP growth and interest payments can be expressed as in equation (4).

$$\tau \times (GDP_{t-1} \times q_t) - D_{GDPlinked} \times (r + (q_t - \mu)) \quad (4)$$

This can in turn be compared to the case when the state has all of its debt in plain vanilla bonds. The revenue side is unaffected, meaning it is identical to equation (2). The cost side, on the other hand, will be affected and consist of the components expressed in equation (5).

$$D_{PlainVanilla} \times r \quad (5)$$

Where $D_{PlainVanilla}$ is the debt in plain vanilla bonds. Note that this only represents the fraction of plain vanilla bonds that amounts to the same size as the debt in GDP-linked bonds presented previously, in order to be able to do a fair comparison. This means that the total debt in plain vanilla bonds in the country will be larger than $D_{PlainVanilla}$. We now can express the governmental surplus/deficit from GDP growth and interest payments for the case with no GDP-linked securities as in equation (6).

$$\tau \times (GDP_t \times q_t) - D_{PlainVanilla} \times r \quad (6)$$

The simplified model of the economy is now outlined for both the case when GDP-linked securities are part of the debt structure and when it is not. The benefits from growth from the perspective of the country for the two cases can now be compared. The comparison is shown in equation (7).

$$\tau \times (GDP_{t-1} \times q_t) - D_{GDPlinked} \times (r + (q_t - \mu)) - \tau \times (GDP_{t-1} \times q_t) - D_{PlainVanilla} \times r \quad (7)$$

The equation shows that when the annual growth is larger than the trend, that is when $q_t - \mu > 0$, then the benefits of growth will be larger for plain vanilla bonds than for GDP-linked bonds. This means that after converting some share of the national debt to GDP-linked bonds there is a cost associated with excess growth.

Government surplus on GDP growth

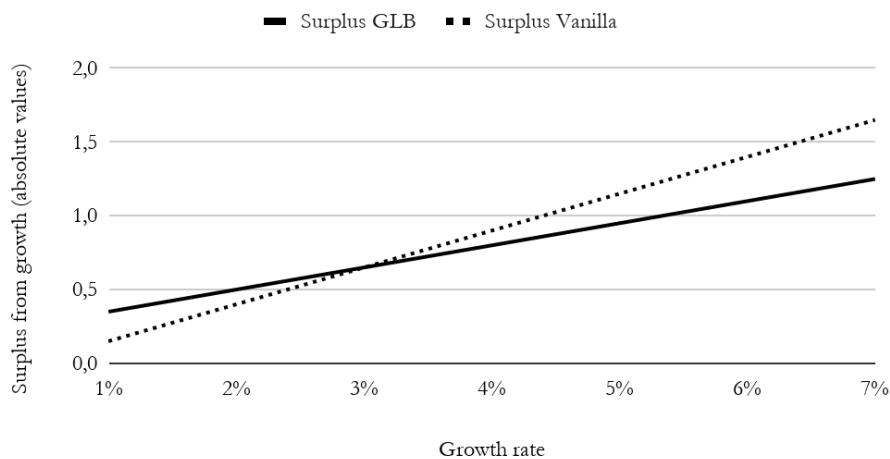


Figure (1). Source: Own illustration

To make this clear, we present a simple numerical example, where D is assumed to be 10, GDP_{t-1} is assumed to be 100, r is assumed to be 1%, τ is assumed to be 25%, and μ is assumed to be 3%. The graph in Figure (1) shows how large the surplus from growth is, from the government's perspective in absolute terms, as a function of the growth rate. As shown, the larger the growth rate, the less beneficial it is for the government to grow when having debt converted to GDP-linked bonds compared to plain vanilla bonds.

5.2. *The impact on allocation of government spending*

The previous section settled that excess growth is associated with higher costs, and hence less beneficial from the government's point of view when debt is converted to GDP-linked bonds. The next step of the analysis is to evaluate how this fact may affect government spending. To do this, a framework for allocation of government spending is needed. The literature presents a wide range of

such models, although for this purpose, the framework developed by Devarajan et al³³ is going to be used. Devarajan et al's model makes the distinction between growth enhancing (productive) and non-growth enhancing (unproductive) public expenditures, making it well suited for the analysis of a potential shift in allocation of government spending.

The model assumes that the aggregate production function consists of three components: The private capital stock, k , productive government spending, g_1 , and unproductive government spending, g_2 . g_1 is defined so that an increase in spending allocated towards it will increase growth, while the opposite is true for g_2 . What is productive and unproductive depends on the situation in the particular country. For example, in a country lacking railways an example of g_1 would be investing in railways, while an example of g_2 could be to invest in an expensive opera house. The relationship between them is then expressed as

$$y = f(k, g_1, g_2) = \left[\alpha k^{-\varsigma} + \beta g_1^{-\varsigma} + \gamma g_2^{-\varsigma} \right]^{-1/\varsigma} \quad (8)$$

Where $\alpha > 0$, $\beta \geq 0$, $\gamma \geq 0$, $\alpha + \beta + \gamma = 1$, $\varsigma \geq -1$. It is assumed that the tax rate is flat and that

$$\tau y = g_1 + g_2 \quad (9)$$

This paper disregard k as private capital is assumed to be unaffected by the national debt structure, and will instead focus on the allocation between g_1 and g_2 .

Assuming that there are other aims besides growth that is worth pursuing in a society, the government is faced with a trade-off between allocating money to g_1 and promoting growth and

³³Devarajan, Shantayanan, Swaroop, Vinaya, and Zou, Heng-fu. 'The Composition of Public Expenditure and Economic Growth', *Journal of Monetary Economics*, vol. 37/no. 2, (1996), pp. 313-344.

allocating money to g_2 and promoting these other values. Assuming diminishing marginal utility of both growth and the other values in society, the trade-off can be illustrated using the standard theory of indifference curves with budget constraints. On the indifference curve (illustrated in blue in Figure (2)), the total utility of GDP-growth, i.e. spending on g_1 , and the other values, i.e. spending on g_2 , are the same while the allocation between the two categories vary. The budget constraint (illustrated in red), display the possible combinations of spending on g_1 and g_2 , provided the constraint in (9). The theory suggests that from a utility maximizing government agent's point of view, the optimal allocation between g_1 and g_2 is where the two curves tangent (see Figure (2)).

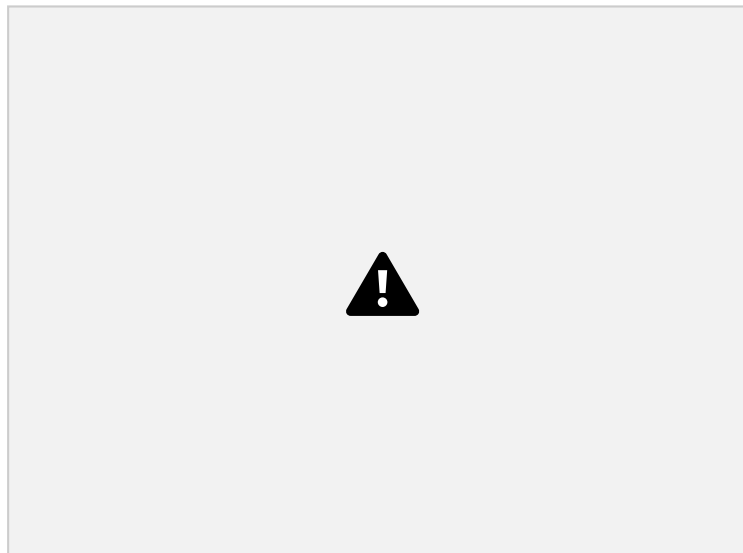


Figure (2). Source: Own illustration

Introducing GDP-linked bonds into the debt structure changes the budget constraint, since, as shown in section 5.1, excess growth now comes with increasing costs, and symmetrically, decreasing growth comes with an eased debt burden. This means the condition in (9) will change so that productive spending (g_1) is relatively more costly than the unproductive (g_2) spending. This can be illustrated using the cost function from (3) in section 5.1. Assuming growth is larger than the trend, so that the excess growth ($q_t - \mu$), is > 0 , the excess growth is called ϵ , and the equation in (3) can be rewritten as

$$D_{GDPlinked} \times (r + \epsilon) = D_{GDPlinked}r + D_{GDPlinked}\epsilon \quad (10)$$

The same thing can be done from the opposite perspective, when growth falls short of the trend, meaning $(q_t - \mu)$, is < 0 . Calling the absolute value of this lacking growth ι , the equation can be written as

$$D_{GDPlinked} \times (r - \iota) = D_{GDPlinked}r - D_{GDPlinked}\iota \quad (11)$$

As productive spending increase growth and unproductive spending decrease growth, the budget constraint can now be expressed as

$$\tau y_{GDPlinked} = (g_1 - D_{GDPlinked}\epsilon) + (g_2 + D_{GDPlinked}\iota) \quad (12)$$

The effect is a shift in the slope of the budget constraint, leading to a shift in utility maximizing allocation between g_1 and g_2 as illustrated in Figure (3). The indifference curve (in blue) and the original budget constraint (in red) is identical to that of Figure (2). Added is the new, GDP-linked, budget constraint (in green).

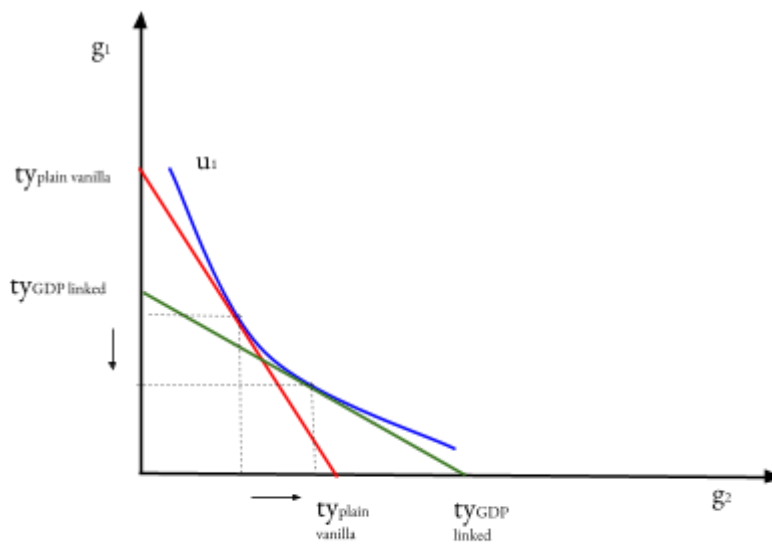


Figure (3). Source: Own illustration.

As addressed earlier, the government faces a trade-off between allocating means to growth and to other—non growth enhancing but, nevertheless, utility creating—values. Introducing GDP-linked bonds into the debt structure will affect the relative costs associated with spending money productively versus unproductively. This leads to a shift in optimal allocation of public spending, in favor of more unproductive spending. As investors are unable to fully observe and control governments decisions on allocation after the contract is implemented, the finding of a shift in optimal allocation will pose a moral hazard problem in the post-contract period.

6. Discussion

Hereafter follows a discussion around the results, implications and practical applicability. It will be carried out in the following way. Firstly, a section evaluating potential problems arising from the findings of reallocation of public expenditures will be presented. Secondly, a section around ways to mitigate the potential problems will follow. Lastly, there will be a discussion where the theoretical findings are set in a practical perspective.

6.1. Implications and potential problems

After establishing that the model predicts a reallocation of public expenditures towards more unproductive spending, a discussion around the implications and potential problems of the finding will follow.

Firstly, from the perspective of future investors, it can be noted the identified mechanism increases the risk for investors, as it creates concerns about governments not optimizing growth. Moreover, it is worthy to note that as D increases—that is that the fraction of the total debt in GDP-linked bonds to the total debt in the country increases—the larger the effect of this mechanism will be. This is illustrated in Figure (4), using the same simple numerical example as in Figure (1).

Government surplus on debt

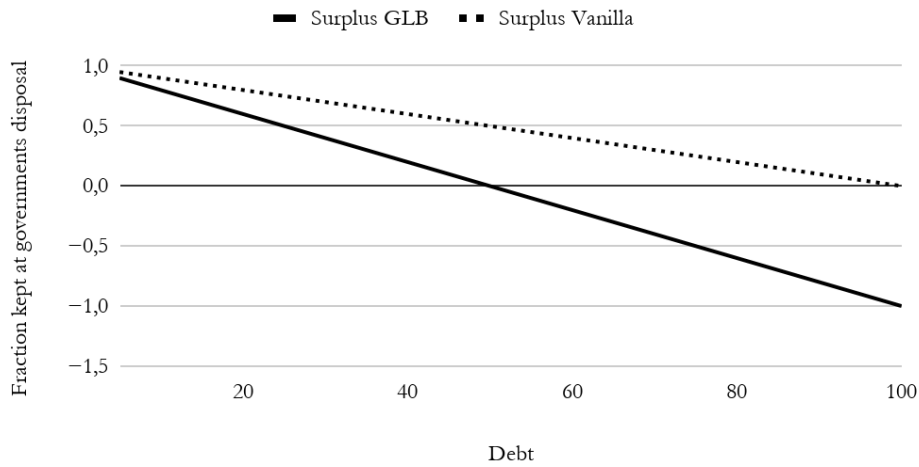


Figure (4). Source: Own illustration.

However, instead of having the fraction kept at the government's disposal as a function of the growth rate, we here present the fraction as a function of D , keeping the growth rate fixed at 4%. The illustration shows how the cost of growth increases with the share of debt in GDP-linked bonds. It also illustrates that there exists combinations of debt levels, growth rates and levels of r where the incremental surplus from the government point of view is negative. This implies that investors are going to have to be observant on the ratio between $D_{GDPlinked}$ and the total debt, as the risk increase with the level of $D_{GDPlinked}$.

However, the mechanism as such is not necessarily problematic from the investor point of view as the market will anticipate the mechanism and price GDP-linked bonds accordingly. This means for investors, the mechanism is simply a matter of assessing the risk and its implied price. For governments and countries, on the other hand, it becomes problematic, as it implies investors demanding a higher risk premium and thereby a higher interest rate. This in turn implies that it is in the issuing country's best interest to do what it can to ensure investors that the money will be used productively. This means governments are faced with a problem of credible commitment. A discussion around how this can be mitigated will follow in section 6.2.

Another issue from the issuing country's point of view is if the introduction of GDP-linked bonds, and hence the potential reallocation of government spending risks to hurt the country as a whole. Assuming the budget was optimally allocated before the introduction of the new debt instrument, then the introduction of GDP-linked bonds risks hurting the economy and the country as a whole by, potentially, jeopardizing important investments. A risk of wasteful spending potentially arises as well. The money allocated in g_2 represents all spending that does not increase growth. Even if there, as mentioned earlier, are other utility increasing means worth pursuing in a country, there is also a risk that money is spent more freely on wasteful projects when productive spending gets relatively more costly.

6.2. *How to mitigate the problematic effects*

This section constitutes a discussion around ways to mitigate the anticipated problematic effects of reallocation when implementing GDP-linked bonds into the debt structure. As identified above, the state issuing GDP-linked bonds is faced with a problem of credible commitment. It is in the country's best interest to do what it can to ensure investors that it will use the money productively. As there is yet no example of countries issuing GDP-linked bonds, no empirical analysis of previous actions can be done. However, as GDP-linked debt has features closely related to both insurance policies and equity in companies, guidance can be found in the private sector and in the finance literature.

6.2.1. Signaling through transparency

In the finance literature there are several actions that are implemented to reduce moral hazard and information asymmetry. Signaling is one such action, by which the more informed can credibly reveal their private information to the less informed and thereby signal its credibility. The key idea is to find an action that is more costly for the non-credible actor than for the credible, resulting in only the trustworthy actor taking on the action.³⁴

³⁴Connelly, Brian L., Certo, Travis S., Ireland, Duane R., and et al. 'Signaling Theory: A Review and Assessment', *Journal of Management*, vol. 37/no. 1, (2011), pp. 39-67.

One potential way for the state to signal is through increased transparency. This could be obtained if the issuing country adopted a strict framework exposing how the money stemming from the GDP-linked bonds will and has been used. A similar process was adopted before the issuance of the first green bonds in Sweden. In the case of the green bonds, the Swedish Government adopted a framework under which investors easily can track how their investment is used and what environmental consequences can be expected as a result³⁵. Opening up for transparency by adapting a framework for reporting could be a way forward also in the case of GDP-linked bonds, as it can function as a signal of sound policies. Such a strategy would be easier to adopt in developed countries, perhaps members of the European Union, which already has a high degree of transparency and could adopt such a framework without it getting too costly. If the state can commit to a high degree of transparency, it also knows that it will be punished by investors if allocating money unproductively. This, by investors and issuers, shared knowledge can decrease potential scepticism regarding productive allocation amongst investors and hence decrease the required risk premium.

6.2.2. Monitoring

A related way forward is for the issuing country to allow for monitoring. The benefits of monitoring have been studied in the insurance literature, which faces a similar principal agent problem as identified in this paper. For example, Doherty and Smetters find that monitoring is an effective tool to reduce moral hazard if the two involved parties are affiliates, but that it is too costly, and hence ineffective if the parties are non-affiliates³⁶. This means, applying monitoring in GDP-linked bonds contracts could be an efficient way to reduce the moral hazard if the cost is sufficiently low. The paper shows that the cost is sufficiently low if the parties are affiliates, because there is already a large degree of transparency in place. States and investors are not affiliates, however there are already existing monitoring frameworks in place in many states, particularly in developed

³⁵Government offices of Sweden. 'Framework for sovereign green bonds in place', <https://www.government.se/49bcc9/contentassets/ed959d7b700e429a98cc85bdb64ef1af/swedens-sovereign-green-bond-framework.pdf> 06/2020. [accessed: 16/03/2021]

³⁶Doherty, Neil, and Smetters, Kent. 'Moral Hazard in Reinsurance Markets', *The Journal of Risk and Insurance*, vol. 72/no. 3, (2005), pp. 375-391.

countries, for example within the European Union. This means that the cost of extending the monitoring in a way that is going to expose potential unproductive reallocation could be effective.

If the transparency created from the two above suggested actions is not found to have a sufficiently high effect on credibility and hence the risk premium, the state could take further actions in order to credibly commit by including a punishment clause. In that case, it will be wise to transfer some of the government's power to a monitoring third party, which is given the authority to issue fines if it is discovered that the state is allocating money unproductively. Analogies to this situation can be drawn from the development in England after the glorious revolution, when a transfer of power from the Crown (to the parliament, the courts and the Bank of England), showed to be a successful way to commit credibly³⁷. To reduce the cost, the party monitoring in the case of GDP-linked bonds should preferably be an existing organization that already has insights in the state's finances, such suggested suitable organizations could be the IMF, the European Central Bank, or the OECD.

6.3. The theoretical findings in a practical perspective

This section aims to set the theoretical findings in a practical perspective. It can seem unrealistic that politicians would let a reduction in interest rate affect the growth enhancing spending in society. Especially since there are mechanisms in society pushing in the opposite direction of the reallocation effect. To name a few, politicians want to get reelected, countries are more likely to receive financing if growth prospects are high, the country needs to uphold its international reputation, citizens are expected to protest if growth declines, and so are the political opposition. A potential credit rating³⁸ is also of high significance, as it is largely impactful on the required risk

³⁷North, Douglass C., and Weingast, Barry R. 'Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth-Century England', *The Journal of Economic History*; J.Eco.History, vol. 49/no. 4, (1989), pp. 803-832.

³⁸ Note that the issue of rating GDP-linked bonds has not yet been solved. There is yet no methodology and as of now, the two largest rating agencies would not rate GDP-linked bonds as the principal is not guaranteed the original value or given full principal protection. To read more about this problem see, Beers, David T. 'Credit Ratings and the New Market for GDP-Linked Bonds', in Benford, James, Ostry, Jonathan D., and Shiller, Robert J. eds., *Sovereign GDP-Linked Bonds: Rationale and Design*, CEPR Press, (2018). 109-119.

premium³⁹. This list can be made longer as the benefits of growth are largely impactful in society. However, it is important to note that the above analysis in 5.1 and 5.2 is made on the margin and in comparison to plain vanilla bonds. This means that all else equal, there are incentives to relocate government spending when substituting some fraction of national debt into GDP-linked bonds.

Secondly, there is a question about magnitude. The argument could be made that the increased interest rate has such a small impact on the overall expenses in the country that it will not impact the economy. Hence, that the potential reallocation effect shall be ignored when making the decision to implement GDP-linked bonds. However, it is worth noting that the increased interest rate in booms, which is when there are concerns about reallocation, is fully symmetrical to the eased debt burden in recessions. The main argument for implementing GDP-linked bonds is that it decreases the risk of default and increases fiscal space. If the magnitude of the relieved debt burden in bad times is considered to be large enough to impact the economy, then the increased costs in good times, and hence the reallocation effect, is equally impactful in times of booms.

7. Conclusion

The purpose of this thesis was to analyze if there is a risk of suboptimal allocation of government spending when implementing GDP-linked bonds. It also aimed at answering if there are ways to mitigate the effect. To answer the research question, a theoretical model was constructed based on the theory of budget constraints and indifference curves, as well as the theory of productive and unproductive spending. The analysis concludes that implementing GDP-linked bonds leads to a shift in allocation of government spending in favor of more unproductive spending. As actions by government officials in the post-contract period are non-contractible and non-observable, investors face a moral hazard problem when investing in GDP-linked bonds. This is likely to increase the demanded risk premium. To mitigate the moral hazard effect, and hence a high risk premium, the paper suggests decreasing the information asymmetry by increasing transparency and monitoring.

³⁹ Beers, David T. 'Credit Ratings and the New Market for GDP-Linked Bonds', in Benford, James, Ostry, Jonathan D., and Shiller, Robert J. eds., *Sovereign GDP-Linked Bonds: Rationale and Design*, CEPR Press, (2018). 109-119.

7.1. Limitations and future research

The theoretical model constructed in the analysis is based on the design of GDP-linked bonds proposed by Borensztein and Mauro. The strict applicability of the results is hence limited to GDP-linked bonds using the same design. However, all proposed designs of GDP-linked bonds are based on the principle of counter-cyclicalities, indicating that the results generalize to other proposed designs. Performing the analysis on other designs to secure this relationship would be desirable in future work. Furthermore, the analysis is limited to the impact on government spending and fiscal policy. As monetary policy has similar effects on growth, it is possible that similar mechanisms apply to monetary policy. Hence, an analysis of the effects on monetary policy would be worthwhile for future research.

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