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GDP-LINKED BONDS

Yasin Kürşat Önder (Vakgroep Economie)

FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

KEY FINDINGS

- The default risk of Belgium government on its debt is currently low but concerns arise as Fitch downgrades Belgium’s credit rating from stable to negative.

- The concept of linking debt payments to changes in GDP became popular again during the debt crisis of the 1980s and gained even more attention during the COVID-19 pandemic. My research suggests that the benefits of this idea depend on how it is implemented, and are greatest when payments are directly linked to changes in GDP.

- Past experience with GDP-linked bonds, particularly the failure of Argentina's experiment and the success of Portugal's engineering with these financial assets, suggests that the design of the contract is key.

- By using an optimized indexed debt approach, default risk can be eliminated, consumption volatility might be halved, and asset prices can rise although government debt balances increase. These changes occur because a carefully chosen indexation method can improve market completion.

INTRODUCTION

Concerns have been raised about the growing debt burden of the Belgian government, which was already high before the COVID-19 crisis and has been exacerbated by it. These concerns have been amplified by Fitch's recent downgrade of Belgium's credit rating outlook. In this Gents Economisch Inzicht, I will discuss whether GDP-linked bonds could be a useful tool to avoid a potential default episode. Specifically, the note aims to shed light on whether Belgium should start experimenting with these new financial products now in order to prepare for a possible debt crisis and to have a broader range of tools to address it.

What are GDP-linked bonds? These are sovereign financial instruments where the interest payments and/or principal repayment are tied to the economic performance of a country. Specifically, the payments are linked to the country's Gross Domestic Product (GDP) or it can also be linked to a related economic indicator, such as its tax revenues or to a price of a commodity if the country is a resource rich economy.

These bonds gained popularity during the debt crisis of the 1980s. More recently, there has been renewed interest in these financial instruments, following the debt crisis in Europe and the COVID-19 pandemic. As a result, policymakers and organizations such as the G20 have focused their attention on GDP-linked bonds, issuing a statement calling for further analysis and setting up study groups to facilitate the use of these financial securities. These bonds are still a relatively new and niche financial instrument, and their effectiveness and suitability for different countries and investors are still the subject of debate.

There are differing views on the potential benefits of GDP-linked bonds. Proponents of these instruments argue that they can act as an automatic stabilizer by offering lower payment promises during economic downturns and higher payments during periods of growth. This could lead to improved financial and macroeconomic stability and reduced default risk. It could also provide governments with the fiscal space needed to pursue countercyclical fiscal policies. Conversely, during periods of high growth, the requirement for higher payments due to indexation may limit the government's willingness to issue new bonds, thereby improving fiscal discipline.

Critics of GDP-linked bonds are concerned that governments may manipulate GDP statistics, causing investors to pull out of the market and potentially triggering a debt crisis. In addition, some critics argue that the potential benefits of GDP-linked bonds are limited and may even result in losses. This view is supported by previous unsuccessful issuances of GDP-indexed bonds used in debt restructuring efforts for Bulgaria, Bosnia, Costa Rica in the 1990s, and Argentina in 2005. Table A1 at the end provides a list of countries that have issued GDP- and commodity-linked bonds, as well as assets with disaster clauses which triggers a suspension of payments. The table provides brief explanations.

In this GEI, I first summarize Argentina's and Portugal's experimentation with these financial assets. These experiences are important as Argentina's experience with GDP-linked bonds is considered to be a failure while Portugal's is viewed a success. I then use my research where I formally evaluate the introduction of these assets in a quantitative model which has been commonly used in studies of fiscal policy with default risk. My research finds that the success of GDP-linked bonds depends on proper contract design, which can benefit both the government and investors.

PREVIOUS EXPERIENCES

A number of countries have issued GDP-linked bonds or warrants. Table A1 provides an overview of several past instances where payments have been indexed to either GDP or a commodity, along with a brief explanation of each. While some of these instances were implemented as part of a debt-restructuring program, Portugal and Singapore have also experimented with these bonds independently of such a process. In Singapore's case, the shares issued were limited in number and only available to lower-income individuals for wealth redistribution. Portugal's experience was more significant, with indexed bonds accounting for around 6.7 percent of total government debt (as reported by Pina (2022)). However, neither Singapore's nor Portugal's certificates were tradable. Below, I provide more detail on the experiences of Argentina and Portugal. Each case has unique features. Argentina's case underscores the importance of contract design, as the complexity of the

arrangement is believed to be one factor contributing to its failure. On the other hand, Portugal's experience with state-contingent assets can be viewed as a success, but the country's warrants were not tradable, unlike those of Argentina, and further design adjustments may be needed.

To connect my quantitative model to real-world experiences, most countries that have implemented indexed payments typically include a minimum payment level and a threshold that must be reached before payments are triggered. In the model, this threshold corresponds to a country's long-term growth trend. Some countries, such as Ukraine, Argentina, and later Portugal, have also introduced a maximum payment level.

Catastrophe bonds are an example of a growing trend that is similar to the "suspension on payments" indexation method examined in this paper. These bonds allow for payment suspension following a disaster and are considered to be free of moral hazard compared to GDP-linked bonds, where investors may be concerned about the intentions of policymakers. Additionally, as natural disasters can be costly for states, these bonds offer a natural state contingency. Mexico issued these bonds in 2006 and 2009, and Grenada, Peru, Colombia, and Chile have issued similar bonds with disaster/hurricane clauses that allow for a deferral of payment for 6-12 months.

Argentina's experience with GDP-linked bonds is considered to be a failure while Portugal's is viewed a success. We have a lot to learn from their experiences.

Argentina's experience: The complexity of the contract design is a contributing factor to the failure of Argentina's experiment. When it was initially introduced in June 2005 to resolve the debt renegotiation process after the 2001 default, the coupon payments relied on various contingencies. These warrants were issued in different denominations (Argentine pesos, US dollars, Euros, and Yen) and jurisdictions (Argentine, British, Japanese, and New York jurisdictions). In summary, coupon payments would only be triggered if three conditions were met: (i) real GDP must be greater than the baseline real GDP (if real GDP in 1993 prices in period t is higher than the baseline real GDP in a baseline year. This baseline year is explicitly defined over the horizon of the warrant. It starts with a real growth rate of 4.3 percent and gradually converges to the real growth rate of 3 percent), (ii) real GDP growth rate must exceed the real GDP growth rate of the baseline year, and (iii) cumulative payments cannot exceed 0.48 per unit of security in its corresponding currency. That is, if all these conditions are satisfied, total payment is a fraction of the excess nominal GDP to be distributed among the units of the debt exchange agreement. The fraction would have been 5 percent if every party had participated in the debt exchange arrangement. The participation rate was 76 percent, thus, the fraction is set to be 3.8 percent

The complex design of the asset created challenges in determining its price. When the detached Argentinean warrant began trading six months after its initial issuance, the bonds were being traded at a significant 50 percent discount. Despite a decrease in spreads by 400 basis points, the bonds were still not being traded at the expected fair value as determined by consensus expectations.

Portugal's experience: According to Pina (2022), Portugal's experiment with GDP-linked bonds has been successful. These bonds were offered to investors based on a subscription model, where the Treasury sets the terms and conditions and investors decide how much to hold. Portugal issued two GDP-linked bonds in 2013 and 2017 with maturities of 5 and 7 years, respectively. The first issue, which was worth €3 billion and was due to mature in 2016, had a growth threshold of 2 percent and a floor of zero percent. The second issue, worth €1.5 billion, had a growth threshold of 1.5 percent and a floor of 0.75 percent. Both issues were considered successful, with oversubscription ratios of 2.6 and 1.8, respectively. The Portuguese government indicated that the bonds helped to diversify its investor base and reduce financing costs. However, as mentioned earlier, these bonds were not tradable. These bonds promised a minimum return and additional payments based on real GDP growth. Except for 2020 and 2021, these bonds made extra payments to investors as real GDP growth exceeded expectations. To improve the market for GDP-linked bonds, policymakers could make these bonds available in primary dealer markets and allow for payments to decline during economic downturns, enabling

sustainable borrowing and resilient budget balances in the face of economic shocks.

While some countries have experimented with GDP-linked bonds, none have used the unfloored indexation method analyzed below. The novelty of these financial instruments, as elaborated in (1993) and Shiller (2012), is to have a market that shares macroeconomic risks. The unfloored method allows for full state-contingency without any arbitrary restrictions or floors on payments, which makes it a more efficient instrument for risk-sharing between the government and investors. However, there may be practical and political barriers to implementing such a scheme, and countries may prefer to use more conventional debt instruments instead.

Before moving into the sections of the quantitative model, I want to point out some concerns about the practicality of implementing GDP-linked bonds, such as the possibility of data revisions or changes in the methodology used to calculate GDP. Some researchers have suggested creating independent institutions to manage data revisions and make necessary adjustments for subsequent payments, similar to the system used for inflation-indexed bonds issued by the United Kingdom. Alternatively, as Portugal has experimented with, payments may remain unchanged after data revisions. If GDP calculations are modified, the previous series to which the indexed coupons are linked may be retained. The G20 is organizing workshops and policy initiatives to facilitate the issuance of these bonds by addressing potential operational challenges.

METHODOLOGY

In a recent UGent working paper, I am introducing a GDP-linked asset to an otherwise standard quantitative default model which has been commonly used in studies of fiscal policy for countries with default risk. The government has two bonds in its portfolio–non-contingent bonds and GDP-linked bonds–both of which have long-term maturities. An important ingredient is how payments are indexed. Typically, these indexation methods depend on a threshold GDP growth to tie payments. For instance, contracts can entail that payments are tied whether the sovereign's GDP exceed or fall a threshold GDP growth rate of its long-run trend. This is of course country specific. Our model is calibrated to capture the historical relationship between the level of aggregate income, government debt and spreads in economies at risk of default.

RESULTS

I initially present the simulation results of the baseline model (economy without GDP-linked bonds) and match the target statistics. Then I introduce GDP-linked bonds. Table 1 presents the results. Column (1) of Table 1 presents the data moments and column (2) presents the baseline moments that are obtained without GDP-linked. The simulation results of the baseline economy match both the long-run sovereign debt moments and the business cycle moments reasonably well. The last column presents results when we introduce GDP-linked bonds to the benchmark economy without changing any parameter values.

Model predictions match several features of the Argentinean data, including average levels of sovereign debt and spreads. This gives confidence that the model can provide useful quantitative insights into the effects of introducing GDP-linked bonds. An optimized linked debt strategy has the potential to eliminate default risk, reduce consumption volatility by 50%, and raise asset prices, even as it increases the government's debt balances. This is due to the more effective market completion achieved through the optimal choice of indexation method.

Proponents of this indexation method are right in their conjecture that more funds can be raised and the spreads are mitigated. In this formulation, debt obligations would be mitigated if the current income realization is below the mean trend income. Thus, these contracts act like an automatic stabilizer by facilitating countercyclical borrowing policy. That is the government is able to generate higher (lower) debt during economic downturns (upturns).

A noteworthy finding is that well-designed GDP-linked debt can almost completely eliminate defaults, and without significantly increasing the debt-to-GDP ratios. Essentially, the government avoids issuing GDP-linked debt for states with high incomes, and instead borrows during periods of low income to smooth out

consumption. In other words, the government transfers resources from prosperous states by borrowing during times of economic hardship. This approach requires active debt management. In some simulations, the government finances the buyback of non-contingent bonds by issuing GDP-linked bonds or vice versa. This strategy can benefit the government by reducing costs during adverse income shocks, as it is not required to pay coupons with unfloored payments when issuing GDP-linked bonds. Alternatively, the government may choose to purchase GDP-linked bonds back by issuing non-contingent bonds to avoid paying extra coupon payments during upturns.

Table 1. Key Statistics in the Data and the Simulations

	Data	Benchmark without Indexed bonds	With Indexed Bonds
Mean debt (% GDP)	39.0	39.4	54.6
of which indexed bonds (%)	*n.a.*	*n.a.*	85
Mean spread	7.4	7.3	2.1
Mean indexed bond spread ($)	*n.a.*	*n.a.*	2.3
Default per 100 years	4	3.5	0.1
Consumption/Income volatility	1.1	1.2	0.6

Source: UGent Working Paper

CRISES EPISODES AND GDP-LINKED DEBT

In this passage, I provide a quantitative demonstration that a carefully optimized payment system using coupon-linked unfloored indexation can effectively contribute to preserving debt sustainability and prevent the need for a costly default. To conduct this analysis, I apply the same hypothetical path of income shocks to both the baseline and indexed model economies, and examine the differences in the endogenous variables of the two specifications.

Figures 1 and 2 depict the dynamics of consumption, debt, and asset prices 500 quarters after the implementation of indexed bonds, allowing the long-run averages for all economies under study to be achieved. Figure 1 displays the time-series progression of consumption and income shocks for the economy with indexed debt and the baseline economy. Meanwhile, Figure 1 shows the difference in consumption between the two economies. The underlying sequence of income shocks is presented on the right axis, and the transparent gray-shaded area indicates the periods in which the baseline economy defaults but the economy with indexed debt avoids it.

Carefully optimized GDP-linked bonds can avert debt crises. We present a simulation analysis where the baseline economy defaults but the economy with indexed debt avoids it.

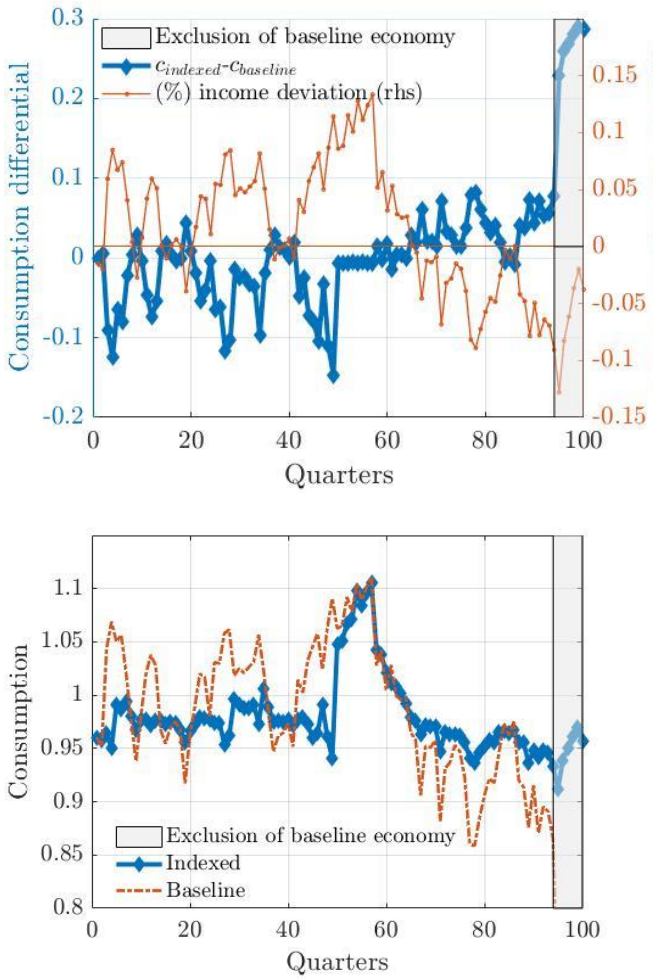
The depicted figure emphasizes that in an economy with indexed debt, consumption is typically higher during adverse income shocks compared to the baseline economy, while it is lower during positive income shocks. Furthermore, the economy with indexed debt manages to avoid a costly default, whereas the baseline economy ends up defaulting. The lower panel of the figure highlights how much smoother the consumption dynamics are in the economy with indexed debt.

It should be noted that between the 50th and 65th quarters, the consumption differential between the two economies shown in the upper panel remains relatively flat at around zero despite positive shocks. During this period, the consumption volatility of the government increases, as illustrated in the right panel. The reasoning for these irregularities is explained in Figure 2.

In Figure 2's upper panel, the time-series paths for non-contingent debt as a percentage of annual mean income (normalized to one) are shown for the baseline economy

(dash-dotted yellow line), the non-contingent debt (solid blue line) of the indexed debt economy, as well as the unfloored debt of the indexed economy (dashed red line). It is evident that the government mainly relies on indexed debt but remains quite active in the debt markets as it adjusts its portfolio according to income realization. As the government experiences positive income shocks from the 40th period onward, it begins to issue more non-contingent debt, leading to a buyback operation in which it repurchases indexed debt using the proceeds from non-contingent debt issuance. This portfolio rebalancing enables the government to avoid making higher payments during a series of positive income shocks. However, this operation results in a level of consumption volatility that is similar to the baseline economy.

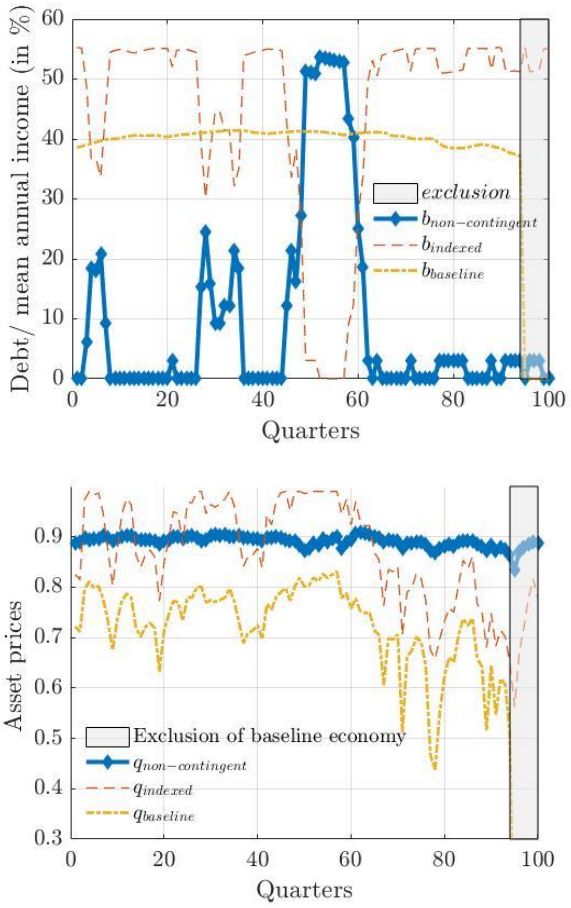
Figure 1– Evolution of consumption dynamics in the baseline economy and in an economy with GDP-linked asset



Source: UGent Working Paper

Figure 2's lower panel presents the time-series paths for asset prices. The asset prices of the indexed economy consistently remain higher than those of the baseline economy. Additionally, it is clear that the price volatility of non-contingent debt in the indexed economy is significantly lower than in the baseline economy.

Figure 2 – Evolution of debt and asset price dynamics in the baseline economy and in an economy with GDP-linked asset



Source: UGent Working Paper

WELFARE DECOMPOSITION

To calculate welfare gains, the compensating variations in consumption are measured to determine the amount required for a household to be indifferent between staying in an economy that exclusively uses non-contingent debt and transitioning to an economy where GDP-linked bonds are an available alternative for borrowing.

Table 2 presents data on the average change in welfare, which was observed to be 2% when transitioning from the baseline economy to the economy that incorporates

GDP-linked bonds. The same table also indicates the sources of these welfare gains, with a significant portion being attributed to the reduction in default frequency achieved by the GDP-linked bonds. This reduction results in a decrease in the income cost of defaulting, leading to a welfare gain of 1.05%. The second most substantial contributor to the welfare gains is a front-loaded consumption profile, which led to an increase in welfare of approximately 0.72%. Lastly, the indexed bonds' lower consumption volatility also contributed to welfare gains, albeit to a lesser extent, with a gain of 0.25%.

Table 2. Decomposition of welfare gains at the time of switch

Welfare gain from cons. paths (%)	**2.03**
From tilting consumption (%)	***0.72***
From lowering income cost of defaulting (%)	**1.05**
From lowering consumption volatility (%)	**0.25**

Source: UGent Working Paper

ROLE OF DEBT MANAGEMENT

In our simulations, the government occasionally finances the repurchase of certain bonds by issuing different types of bonds. This can be advantageous for the government because it may be cheaper to issue certain types of bonds during times of economic hardship. By doing this, the government can avoid having to pay high coupon payments. Conversely, the government may also benefit from repurchasing certain types of bonds to avoid paying extra coupon payments during times of economic growth. To be able to find out the role of such debt management in welfare as well as on moments, in one experiment, buyback operations were not allowed. In the second experiment, the share of each type of debt was set to the average values obtained from simulations, and the government was only allowed to adjust the total amount of debt while keeping shares constant. Specifically, the share of GDP-linked bonds was set to 85% per period, while total debt was allowed to adjust. This was done to determine the upper limit on welfare gains resulting from per-period optimal portfolio allocation. The results showed that although the no-buyback constraint did not significantly influence long-term simulation moments, it still had important effects on welfare. The gains were more than halved in the economy with a no-buyback constraint, demonstrating that buyback operations play a significant role in optimal debt management and achieving higher welfare gains. Additionally, when the government's ability to reshuffle portfolio shares was completely shut off, significant swings in welfare were observed depending on the state of the economy, although average welfare remained positive and significant.

CONCLUSION

The COVID-19 crisis has brought renewed attention to the use of GDP-indexed bonds as sovereigns, including Belgium, started borrowing heavily to support their economies., which were first introduced during the debt crisis in the 1980s. This short-note discussed the potential benefits of introducing GDP-linked bonds and emphasizes the importance of designing the bonds carefully to avoid negative outcomes by documenting Argentina's negative experience and Portugal's success. Poorly designed contracts can result in negligible gains or even losses for governments. Nonetheless, I present a contract that benefits both the government and investors of previously issued debt. The gains are highest when the contract offers symmetric risks where payments decrease during downturns and increase during upturns. I also show that the proposed contract design benefits investors of previously issued debt, as the price of the asset increases following a decline in the likelihood of default, which raises the market value of the debt. These results are robust to a number of different assumptions.

However, the study does not take into account a country's ability or competence to issue these bonds at a reasonable premium. Currently, no country has implemented an indexation method for GDP-linked bonds that ensures symmetrical risk sharing during economic downturns and upturns. This study provides a formal analysis that could inform policy discussions and facilitate the design of an optimal contract that benefits both investors and the sovereign. Without such a design, the issuance of previously unsuccessful GDP-linked bonds may be repeated.

References

Önder, Yasin Kürşat. 2022. “Optimal GDP-indexed bonds.” Ghent University Working Paper, 2022/1056.
Pina, Gonçalo. 2022. “State-Contingent Government Debt: a New Database.” Credit and Capital Markets, 55 (1): 35–66.
Shiller, Robert J. 1993. Macro Markets: Creating Institutions for Managing Society’s Largest Economic Risks. New York, NY: Oxford University Press.
Shiller, Robert J. 2012. Finance and the Good Society. Princeton University Press.

Table A1. Previous Indexed Bond Issuances

Country	Time Issued	Indexation	Note
Argentina	2005	GDP	Part of debt restructuring, payments over a threshold GDP
Bosnia and Herzegovina	1990s	GDP	Part of Brady debt restructuring, payments over a threshold GDP
Bulgaria	1990s	GDP	Part of Brady debt restructuring, payments over a threshold GDP
Chile	*2018*	Earthquake	Catastrophic bonds
Colombia	*2018*	Earthquake	Catastrophic bonds
Costa Rica	1990s	GDP	Part of Brady debt restructuring, payments over a threshold GDP
France	1973	Gold	Following a sharp depreciation of Franc against gold, the cost of burden has increased by 700 percent in 10 years.
Greece	2012	GDP	Payment schedule depends on a number of conditions
Grenada	2015	Hurricane	Catastrophic bonds
Mexico	1970s	Oil	First to issue such bunds, Petrobonds
Mexico	1990s	Oil	Part of Brady debt restructuring
Mexico	2018	Earthquake	Catastrophic bonds
Nigeria	1990s	Oil	Part of Brady debt restructuring
Peru	2018	Earthquake	Catastrophic bonds
Portugal	2013-2017	GDP	Treasury Certificates Savings Growth, Payments over a threshold GDP, linked to coupons with floor
Ukraine	2015	GDP	Part of debt restructuring, annual payments if economic growth crosses certain threshold
Uruguay	1990s	GDP	Part of Brady debt restructuring
Singapore	2001	GDP	Investors are guaranteed to receive coupons each quarter and promised to receive extra returns if GDP exceeds its long-run average. Designed as part of a redistribution scheme
Venezuela	1990s	Oil	Part of Brady debt restructuring

Source: **UGent Working Paper**

Yasin Kürşat Önder holds a Ph.D. in Economics from Georgetown University and was previously an economist at the Central Bank of the Republic of Turkey (CBRT) and a non-resident scholar at Deakin University. His research interests are mainly in international macroeconomics and quantitative economics. His work has been published in various esteemed journals such as the American Economic Journal: Macroeconomics, Journal of International Economics, Review of Economic Dynamics, and Journal of Development Economics. Detailed information on his research interests is available on his website. He can be reached at kursat.onder@ugent.be.

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