Online appendix to "Een Eurozone begrotingsunie zou voor Nederland duur uitpakken"

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November 1, 2022

In this online appendix we provide the calculations behind the results presented in Hoogduin and van der Kwaak (2022). Before we do so, we will first provide three definitions in Section 1. Next, we explain how we calculate the average net fiscal transfer for net contributing states in Section 2, including an explanation for how we correct for a federal surplus or deficit. Then, we argue in Section 3 why there has been little convergence between US states over the period 1997-2021. Afterwards, we derive the formula for the calculation of the net present value of all future net fiscal transfers in Section 4. Finally, we explain in Section 5 how we calculate the net fiscal transfers from pooling existing government debt in the Eurozone.

Finally, the excel files that we refer to can be found via the following weblink: https://sites.google.com/site/christiaanvanderkwaak/popular/online-appendices/online-appendix-to-hoogduin-and-van-der-kwaak-2022?authuser=0

1 Definitions

Before we dive into the calculations, we first define a *net fiscal transfer (netto-overdracht)* as the difference between the Eurozone taxes raised in a member country for the Eurozone budget and the spending from the Eurozone budget that benefits this country.

A member country is a *net contributor (netto-betaler)* if the Eurozone taxes that are levied in this country exceed the amount of funds from the Eurozone budget that are spent in this country: there is a net fiscal transfer from this country to the rest of the Eurozone.

A member country is a *net receiver (netto-ontvanger)* if the funds from the Eurozone that are spent in this country exceed the Eurozone taxes levied in this country: there is a net fiscal transfer from the rest of the Eurozone to this country.

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2 Calculation of net fiscal transfers in the United States

We caculate the net fiscal transfer $F_{j,t}$ of state j in period t in dollars as the difference between the federal taxes $T_{j,t}$ levied in state j, and the expenditures $E_{j,t}$ in state j that are financed from the federal budget. Both $T_{j,t}$ and $E_{j,t}$ are expressed in dollars. Therefore, the net fiscal transfer $F_{j,t}$ of state j in period t is equal to:

$$F_{j,t} \equiv T_{j,t} - E_{j,t}. \tag{1}$$

The net fiscal transfer $f_{j,t}$ as a percentage of nominal GDP $Y_{j,t}$ of state j in period t is then given by:

$$f_{j,t} \equiv \frac{F_{j,t}}{Y_{j,t}}. \tag{2}$$

However, the redistribution between US states via the federal budget is not properly captured by this measure when the federal budget has a surplus or deficit. Since federal taxes are levied in the states, and most federal expenditures are done within US states, the federal government running a deficit will most likely imply $\sum_j F_{j,t} < 0$ (where the summation is performed over all US states).[1] In that case, the net fiscal transfers from net contributing states is understated. Likewise, a federal surplus will most likely imply $\sum_j F_{j,t} > 0$, as a result of which the net fiscal transfer from net contributing states is overstated.

To correct for this, we subtract the average net fiscal transfer $\bar{F}_t \equiv \frac{1}{N}\sum_j F_{j,t}$ in dollars in period t from state j's net fiscal transfer $F_{j,t}$ in period t to obtain the deficit-corrected net fiscal transfer $F^*_{j,t}$ of state j in period t:

$$F^*_{j,t} \equiv F_{j,t} - \frac{1}{N}\sum_j F_{j,t}, \tag{3}$$

where N denotes the total number of US states. Next, we calculate the deficit-corrected net fiscal transfer $f^*_{j,t}$ of state j in period t as a percentage of nominal GDP $Y_{j,t}$:

$$f^*_{j,t} \equiv \frac{F^*_{j,t}}{Y_{j,t}}. \tag{4}$$

Finally, we define net contributing states as states for which $f^*_{j,t} > 0$ in period t. We indicate these states by k, which is a subset of all the states j. Next, we calculate the average net fiscal transfer $\hat{f}_t$ of net contributing states in period t in the following way:

$$\hat{f}_t = \frac{\sum_k Y_{k,t} f^*_{k,t}}{\sum_k Y_{k,t}}, \tag{5}$$

which implies that $\hat{f}_t$ denotes the average net fiscal transfer weighted by the nominal GDP.

[1] The federal government also has expenditures that benefit other countries, such as development aid.

Now we calculate the nominal GDP-weighted average net fiscal transfer for data from The Economist (2011) in the file "US transfer calculations Economist.xlsx". Unfortunately, the The Economist (2011) data only contain the sum of all federal taxes and expenditures per state over the entire period 1990-2009, with no split of federal taxes and expenditures per year. We follow The Economist (2011), and use the 2009 nominal state GDP for normalization of the net fiscal transfers over the entire period in equation (5), after which we divide by 20 to obtain an estimate for the average net fiscal transfer per year of net contributing states. Doing so, we find that the nominal GDP-weighted net fiscal transfer of net contributing states is equal to 2.8% of state GDP, see sheet "transfers computations (2)".

The file "US transfer calculations Economist.xlsx" also contains Figure 1 from Hoogduin and van der Kwaak (2022) in sheet "Net fiscal transfers (BEA)". The vertical axis displays the net fiscal transfer (2) as a percentage of state GDP, while the horizontal axis displays the real GDP per capita in 2009, which can be found in the sheet "real GDP per capita". This last sheet, in turn, was obtained from data of Bureau of Economic Analysis (2022) and is computed in the file "US_state_real_GDP_per_capita_extended.xlsx". Note that a very similar figure as Figure 1 from Hoogduin and van der Kwaak (2022) can be found in Van der Kwaak (2021).

The Rockefeller Institute of Government (2022) data contain the federal taxes and expenditures per state for each year over the period 2015-2020, see the file "US transfer calculations Rockefeller.xlsx". We exclude the year 2020 because of large corona related expenditures. We download each state's nominal GDP $Y_{j,t}$ over the same period from Bureau of Economic Analysis (2022), see sheet "Nominal GDP". We take the average of $\hat{f}_t$ over the period 2015-2019 to arrive at a nominal GDP-weighted net fiscal transfer of net contributing states equal to 3.5% of state GDP, see sheet "NFT creditors (% GDP) (correct)".

The file "US transfer calculations Rockefeller.xlsx" also contains the equivalent of Figure 1 from Hoogduin and van der Kwaak (2022) with the average real GDP per capita over the period 2015-2019 on the horizontal axis. Now that we have the net fiscal transfers for each year, we display the (unweighted) average net fiscal transfer over the period 2015-2019 for each state. We do so for the net fiscal transfer (2) in sheet "NFT vs real GDP per capita", as well as for the deficit-corrected net fiscal transfer (4) in sheet "NFT vs real GDP p capita 2". We conclude that the results are similar to Figure 1 from Hoogduin and van der Kwaak (2022).

3 Lack of convergence between US states over the period 1997-2021

In the main text of Hoogduin and van der Kwaak (2022) we claim that there has been very little convergence between US states. This is the case, despite the fact that there have been substantial fiscal transfers between US states in the period 1990-2009 The Economist (2011) and in the period 2015-2019 Rockefeller Institute of Government (2022).

To highlight this lack of convergence, we employ data from Bureau of Economic Analysis

(2022). Specifically, we look at the real GDP per capita for each state in 1997 and the real GDP per capita in 2021. We use the years 1997 and 2021 because they are the earliest, respectively latest, year for which we can compute the real GDP per capita.

We compute the real GDP per capita by downloading each state's real GDP in 1997 and 2021, as well as each state's population size in 1997 and 2021, after which we divide the real GDP by the population size in the respective year to obtain the real GDP per capita. The data can be found in the excel file "US_state_real_GDP_per_capita_extended.xlsx".

Next, we produce in Figure 1 a scatter plot with the real GDP per capita in 1997 on the horizontal axis and the real GDP per capita in 2021 on the vertical axis, which can be found in the sheet "Real GDP per capita 1997-2021" (in Dutch) and in the sheet "Real GDP per capita 1997-2021 E" (in English).

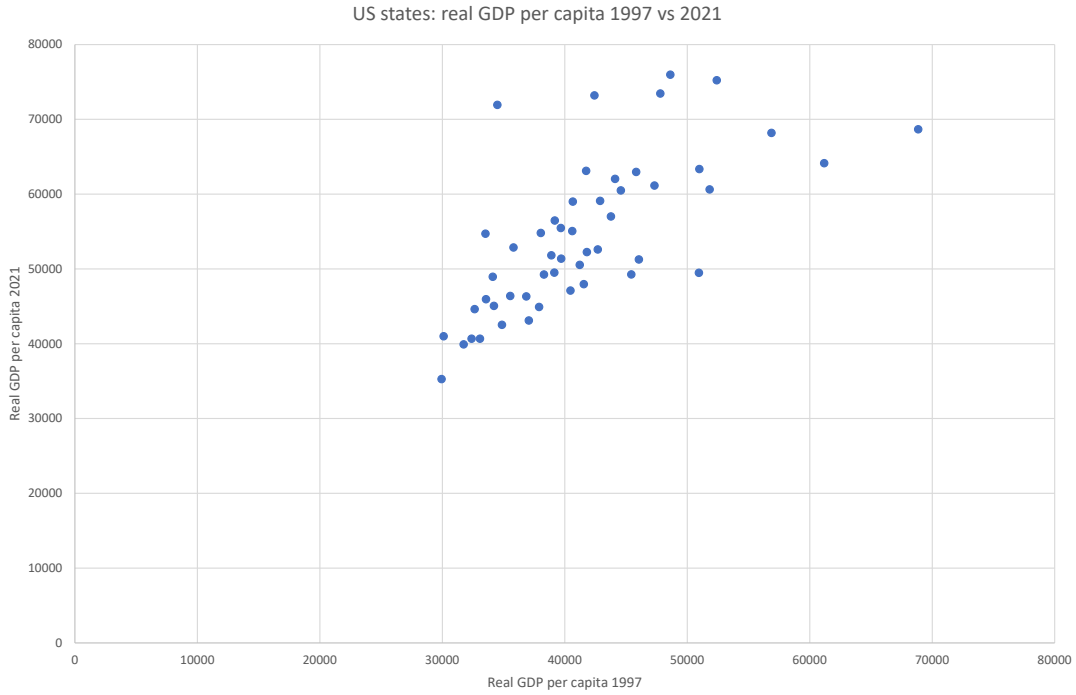

Figure 1: Real GDP per capita in 2021 for US states (vertical axis) versus Real GDP per capita in 1997 for US states (horizontal axis). *Source*: Bureau of Economic Analysis (2022).

First, we see from Figure 1 that in 1997 the real GDP per capita of the richest state (Alaska) is more than twice the real GDP per capita of the poorest state (Mississippi). 25 years later, the gap between the real GDP per capita of the richest state (which is now Massachusetts) is still more than twice the real GDP per capita of Mississippi, which is still the poorest state. We also see a positive correlation between the GDP per capita in 1997 and the GDP per capita in 2021: the larger the real GDP per capita in 1997, the larger the real GDP per capita in 2021 for most states. Therefore, Figure 1 suggests relatively little convergence in terms of GDP per capita

over the 24 year period from 1997 to 2021: convergence would require a more or less horizontal line, which would imply that the real GDP per capita in 2021 is more or less the same, despite dispersion in the real 1997 GDP per capita.

We conclude that there has been relatively little convergence over this 24 year period. This is the case despite substantial net fiscal transfers from rich states (as measured by GDP per capita) to poor states over the period 1990-2009 and 2015-2019 (see Figure 1 in Hoogduin and van der Kwaak (2022) and sheet "NFT vs real GDP per capita" in excel file "US transfer calculations Rockefeller.xlsx").

The result that there is little convergence over multiple decades can also be extended to the Mezzogiorno region in Italy, which has been receiving net fiscal transfers from the rest of Italy amounting to 20-30% of Mezzogiorno GDP per year during most years since World War II (Micossi and Tullio, 1991), a pattern which has not changed in recent years (De Grauwe, 2007). Therefore, we see that receiving large fiscal transfers can be very persistent for multiple decades. Heijerman and Heijerman (2019) show that the gap in the real GDP per capita between East- and West Germany has only been closed by 40% over the period 1991-2017, despite large and persistent fiscal transfers from West- to East-Germany.

Therefore, it is unlikely that a future Eurozone budget will lead to a quick convergence in the real GDP per capita of the different Eurozone countries. This motivates our decision to have forty years of net fiscal transfers in Hoogduin and van der Kwaak (2022).

4 Formula for the net present value of all future fiscal transfers

The goal of this section is to derive a formula for the net present value of all future net fiscal transfers for a country that participates in a fiscal union, which we will express as a percentage of nominal GDP.

First, we define several variables that we will use in the formula to be derived, for which we closely follow Van der Kwaak (2018). Let NPV_t denote the net present value of all future net fiscal transfers in euros in period t. Y_t denotes the nominal GDP in period t in euros. We assume a constant net nominal interest rate r and a constant net growth rate of nominal GDP equal to g. We denote the net fiscal transfer as a percentage of nominal GDP in period $t+j$ by $\left(\frac{F}{Y}\right)_{t+j}$, where j is zero or a positive integer. The net fiscal transfer in euros is then equal to $\left(\frac{F}{Y}\right)_{t+j} Y_{t+j}$ in period $t+j$.

When calculating the net present value of the future net fiscal transfers, we assume that the Eurozone budget starts k periods from now, and that the net fiscal transfers last for n periods. Therefore, the formula for the period t net present value NPV_t of all future fiscal transfers is

given by:

$$NPV_t = \frac{\left(\frac{F}{Y}\right)_{t+k} Y_{t+k}}{(1+r)^k} + \frac{\left(\frac{F}{Y}\right)_{t+k+1} Y_{t+k+1}}{(1+r)^{k+1}} + ... + \frac{\left(\frac{F}{Y}\right)_{t+k+n-1} Y_{t+k+n-1}}{(1+r)^{k+n-1}}, \tag{6}$$

Next, we assume that the net fiscal transfers are constant over time as a percentage of nominal GDP, i.e. $\left(\frac{F}{Y}\right)_{t+j} = \left(\frac{F}{Y}\right)$ for all $j \in \{0, 1, 2, ...\}$. In addition, we can write $Y_{t+k} = (1+g)^k Y_t$ since we assume that the nominal GDP grows at a constant rate g. Substitution into expression (6) gives the following formula for the period t net present value NPV_t as a percentage of nominal GDP Y_t:

$$\frac{NPV_t}{Y_t} = \left(\frac{1+g}{1+r}\right)^k \left(\frac{F}{Y}\right) \left[1 + \left(\frac{1+g}{1+r}\right) + ... + \left(\frac{1+g}{1+r}\right)^{n-1}\right]. \tag{7}$$

From the above formula we immediately see that the net present value $\frac{NPV_t}{Y_t}$ linearly increases in the net fiscal transfer F/Y per period. We also see that we need to distinguish between the case where $r = g$ and the case where $r \neq g$. In the first case, we can immediately write:

$$\frac{NPV_t}{Y_t} = n\left(\frac{F}{Y}\right). \tag{8}$$

Hence we see that the net present value of all future net fiscal transfers (as a percentage of nominal GDP) is equal to the number of years n in which there are net fiscal transfers multiplied by the net fiscal transfer F/Y per period.

In the second case ($r \neq g$), we use the formula for the geometric series $\sum_{i=0}^{n-1} a^i = (1-a^n)/(1-a)$ with $a = (1+r)/(1+g)$ to rewrite expression (7) in the following way:

$$\frac{NPV_t}{Y_t} = \left(\frac{1+g}{1+r}\right)^k \left(\frac{F}{Y}\right) \left[\frac{1 - \left(\frac{1+g}{1+r}\right)^n}{1 - \left(\frac{1+g}{1+r}\right)}\right]. \tag{9}$$

In the main text, we assume that the number of years in which there are net fiscal transfers is equal to forty years, hence we have that $n = 40$, with robustness checks for $n = 30$ and $n = 50$. We assume that the net fiscal transfers that the Netherlands will pay to the rest of the Eurozone is equal to 2.5% per year, i.e. $F/Y = 0.025$. In addition, we assume that the growth rate g of the nominal GDP is equal to 3.25%, i.e. $g = 0.0325$, and that the nominal interest rate r is also equal to 3.25%, i.e. $r = 0.0325$. Finally, we assume that it takes 10 years before the fiscal union is operative and the fiscal transfers start, i.e. $k = 10$ (Hoogduin and van der Kwaak, 2022).

Below, we provide two figures. The first, Figure 2, displays the net present value of all future net fiscal transfers as a function of the years n in which the Netherlands is a net contributor. This figure coincides with Figure 2 in the main text of Hoogduin and van der Kwaak (2022).

The second, Figure 3, displays the net present value of all future net fiscal transfers as a

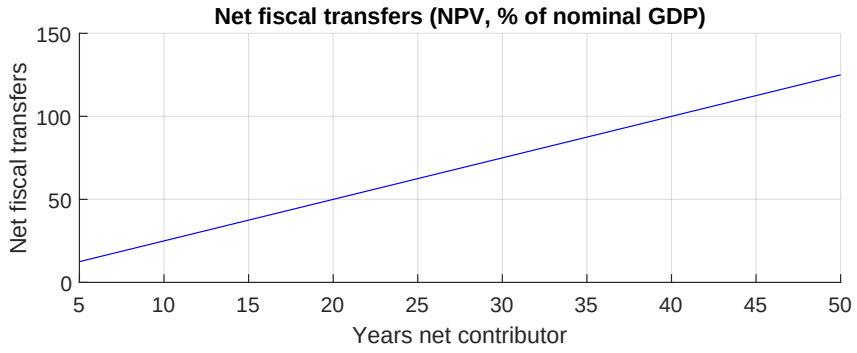

Figure 2: Net present value of all future net fiscal transfers as a percentage of nominal GDP (NPV_t/Y_t, vertical axis) versus the number of years n (horizontal axis) with $k = 10$, $F/Y = 0.025$, $r = 0.0325$ and $g = 0.0325$.

function of the nominal interest r. Just as we report in Hoogduin and van der Kwaak (2022), we see that the net present value of all future net fiscal transfers decreases with the nominal interest rate r. Specifically, we see that the net present value decreases from 100% for $r = 0.0325$ to approximately 43% for $r = 0.065$.

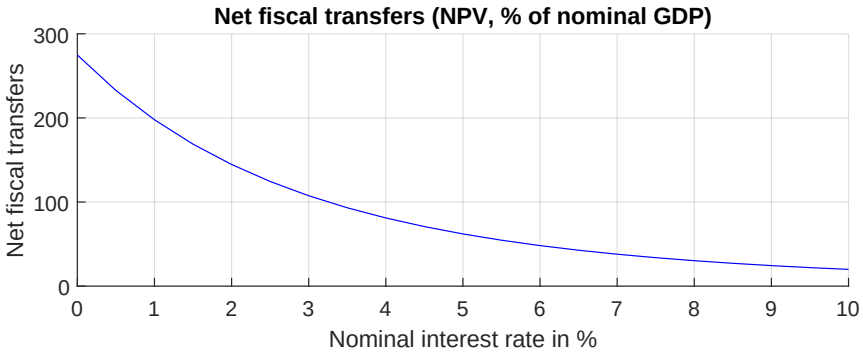

Figure 3: Net present value of all future net fiscal transfers as a percentage of nominal GDP (NPV_t/Y_t, vertical axis) versus the nominal interest rate r (horizontal axis) with $k = 10$, $F/Y = 0.025$, $n = 40$ and $g = 0.0325$.

5 The size of the fiscal transfer from pooling existing debts

In order to perform the net fiscal transfer arising from pooling existing national debt, we perform the following procedure. We denote by B_j the national debt of country j. First, we calculate the total amount of outstanding national government debt B:

$$B = \sum_j B_j, \tag{10}$$

where we sum over the national debts of all Eurozone countries. Next, we denote by x_{NL} the fraction of the debt which is apportioned to the Netherlands. Therefore, the fraction of debt for which the Netherlands is responsible for repayment is equal $x_{NL}B$. As a result, the net fiscal transfer F from the Netherlands to the rest of the Eurozone is equal to:

$$F \equiv x_{NL}B - B_{NL}. \tag{11}$$

The calculations can be found in the excel file "Debt_mutualisation.xlsx", which contains data that were downloaded from Eurostat (2022). First, we calculate the sum of all outstanding national debt of Eurozone countries (10) in the sheets "computations (ECB capital key)" and "computations (GDP)", and find the total debt to be equal to $B = 11.945.126,20$ million euros in 2021Q4, while the Dutch national debt is equal to $B_{NL} = 448.110$ million euros. We take the debt levels in 2021Q4, because this was the latest quarter for which data are available.

In Hoogduin and van der Kwaak (2022), we report the results for two ways in which we determine the fraction of debt x_{NL} for which the funds for repayment need to come from the Netherlands. The first is to use the capital key of the ECB, which is 5.86%, see the sheet "ECB capital key". The second is to use the fraction of the Dutch nominal GDP divided by total Eurozone GDP, which amounts to 7.02%, see the sheet "GDP share". With the help of formula (11), we find the net fiscal transfers of 250 billion euros and 390 billion euros that are reported in Hoogduin and van der Kwaak (2022).

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