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Greece 2010-18: What could we have done differently?

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Greece 2010-18: What could we have done differently?

Cyrille Lenoël¹, Corrado Macchiarelli², and Garry Young³

ABSTRACT

At the beginning of 2010, the fiscal situation of Greece was unsustainable, and an ambitious but costly adjustment plan had to be put in place under a consortium of the International Monetary Fund, the European Commission and the European Central Bank. It took three consecutive adjustment programmes, including debt-relief through private sector involvement, to restore confidence in the economy and achieve a budget surplus. In this paper, we provide a theoretical analysis of the Greek Crisis starting from 2010. We build a series of counterfactuals using the National Institute General Econometric Model (NIGEM) to analyse why the cost of the adjustment in terms of GDP loss and increase in debt-to-GDP ratio turned out to be much worse than expected. In doing so, we analyse three scenarios: (i) one in which we simulate a much more conservative cut in public investment by the Greek central government; (ii) a second scenario of a lower risk-premium, signalling, e.g., lower political and redenomination risks, had the European Central Bank guaranteed its lending of last resort role earlier than 2012; (iii) finally, a similar financial envelope as the one adopted during the first Greek adjustment programme but over a longer period, moving beyond the standard IMF three-year duration programmes. We find that the mix of expenditure cuts and loss of confidence among households and firms explain a large part of the unanticipated costs of the adjustment in the Greek crisis.

Keywords: Fiscal multipliers; Fiscal policy; Government; Public Expenditure; Public Investment

JEL classifications: E62, E63, E68, H54

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1. Introduction

The design and implementation of the Greek adjustment programmes between 2010 and 2018 constituted one of the largest economic challenges since the creation of the euro area. At the beginning of 2010, the fiscal situation of Greece was unsustainable. An ambitious but costly adjustment plan had to be put in place under a consortium of the International Monetary Fund, the European Commission and the European Central Bank. A severe macroeconomic adjustment was inevitable given the size of the fiscal imbalance: it took three consecutive adjustment programmes, each of the duration of about three years, to restore confidence in the economy and to achieve a budget surplus. Successfully restoring market access to Greece was critical to the credibility of the euro area. In this sense, the implications of the Greek crisis extended well beyond Greece. The bailout package that Greece received was large partly because of fears of contagion to other euro area countries. This tested the strength and the limits of the currency union, and of the European project more in general.

In this paper, we provide a theoretical analysis of the Greek Crisis starting from 2010. Critical points in calibrating the Greek adjustment programme concern the economic and financial context, the instruments available, the intended speed of the reforms and the sequencing of policy changes.

We build a series of counterfactuals using the National Institute General Econometric Model (NIGEM) to analyse why the cost of the adjustment in terms of GDP loss and increase in debt-to-GDP ratio turned out to be much worse than expected. In doing so, we analyse three scenarios: (i) one in which we simulate a much more conservative cut in public investment by the Greek central government; (ii) a second scenario of a lower risk-premium, signalling, e.g., lower political and re-denomination risks, had the European Central Bank guaranteed its lending of last resort role earlier than 2012; (iii) finally, a similar financial envelope as the one adopted during the first Greek adjustment programme but over a longer period, moving beyond the standard IMF three-year duration programmes.

While many of the long-term effects of the adjustment might not be observed given that the third programme concluded recently, we find that the mix of expenditure cuts

and loss of confidence among households and firms explain a large part of the unanticipated costs of the adjustment in the Greek crisis.

1.1 The three adjustment programmes

Starting from late 2009, the Greek government quickly lost access to international market funding, as it emerged that Greece had previously underreported its budget deficit. As a result, foreign investors' confidence crumbled, and between 2010 and 2012, the 10-year bond yield on Greek government debt increased dramatically, from around 5 per cent to close to 30 per cent, making it increasingly harder for the Greek government to withstand its debt obligations.

That corresponded also to a period during which the debt stock accelerated in Greece. The sovereign debt crisis turned into an economic depression, with GDP declining by 28 per cent from its 2007 peak, making it one of the worst episodes ever suffered by a developed economy in non-war times.

The financial crisis revealed structural weaknesses in the Greek economy. Greece required three multilateral bailout loans: two three-year loans agreed in 2010 and 2012 from the consortium of the International Monetary Fund, the European Commission, and the European Central Bank. The third programme in 2015, under the new European Stability Mechanism (ESM),

In May 2010, the first economic adjustment programme for Greece was agreed in the form of a Memorandum of Understanding (MoU) totalling EUR 110 billion. The bailout loan, with interest payments set at 5.5 per cent, was conditional on the implementation of fiscal consolidation measures, structural reforms and the privatization of many government assets. To increase credibility, the Greek government created in July 2010 the Hellenic Statistics Authority, an independent body in charge of producing official statistics, spun off from the Ministry of Finance. The first Economic Adjustment Programme (EAP) managed to improve the country's primary fiscal balance by cutting spending and increasing taxes, but at the cost of worsening the ongoing economic recession. The sovereign debt crisis also affected

several other euro area countries including Ireland and Portugal which also received emergency lending.

As the Greek economy moved deeper into recession, in the context of a euro area-wide slump, the adjustment path proved unreachable, and a second adjustment programme was agreed in March 2012. The new programme consisted of an extension of the maturity of the bailout loan from 7 years to 15 years and a reduction in the interest rate from 5.5 to 3.5 per cent. Private institutional investors, including banks, also agreed in March 2012 to write-off half of the Greek debt they held as part of the private sector involvement (PSI) programme to lighten Greece's overall debt burden. This programme helped prevent Greece leaving the euro, which could have destabilized the whole euro area by laying bare the limits of an incomplete monetary union (De Grauwe, 2018). One of the objectives of the second adjustment programme was an ambitious reduction in the debt-to-GDP ratio from 160 per cent in 2012 to 120 per cent by 2020. Once again, the severity of the recession, fuelled by the spending cuts and the tax increases, made that objective impossible to reach within the three years.

As the first two programmes proved insufficient to deal with the structural weaknesses of the Greek economy, in 2015, a third multilateral loan was agreed among the Hellenic authorities, the European Commission, the ECB and the European Stability Mechanism (ESM). The loans agreed over the different programmes were all granted on the condition of the Greek government adopting far-reaching demand and supply-side reforms intended to enable the Greek government to regain access to international debt markets. The third adjustment programme agreed in 2015 totalled EUR 86 billion. The adjustment programme included a wide range of reforms, including tax, pension and justice reforms. The EU also committed to extra investment in Greece as part of the "Juncker plan".

Economic growth finally started to resume in 2017, as deflationary policies enacted during the previous years finally gained traction. The primary balance turned to a surplus that reached more than 4 per cent of GDP in 2018. Greece was able to repay early part of its debt to the IMF in 2019 and raise funding from international debt

markets at a lower cost compared to the cost of servicing debt from International Financial Institutions such as the IMF or the ESM.

However, the damage that the Greek economy suffered from the Great Recession and its follow-up sovereign debt crisis was considerable: GDP per capita declined from 77 per cent as a percentage of the euro area average in 2009 to 57 per cent in 2018. Debt-to-GDP ratio stocked to 180 per cent in 2018, well before the COVID-19 shock.

1.2 Three policy questions

The question dominating the Greek adjustment programme debate is whether the adjustment could have been done less painfully. For this purpose, we look at the key economic issues that underpin the macroeconomic and fiscal path during an adjustment programme; all of which will be tested by providing economic counterfactuals through the National Institute Global Econometric Model (NiGEM) – see Annex for the technical details of the model.

- I. The first issue relates to the role of public investment cuts in the adjustment programmes. Although reducing public investment was not one of the explicit goals of any of the adjustment programmes, public investment was reduced from €14 billion in 2009 to less than €5 billion in 2011; it stayed at a much lower level until the end of the third adjustment programme. This reduction in investment, equivalent to around 2 per cent of GDP, was much larger and more persistent than the reduction of about 0.2 percentage points of GDP planned in the first adjustment programme (Lenoël et al, 2020).

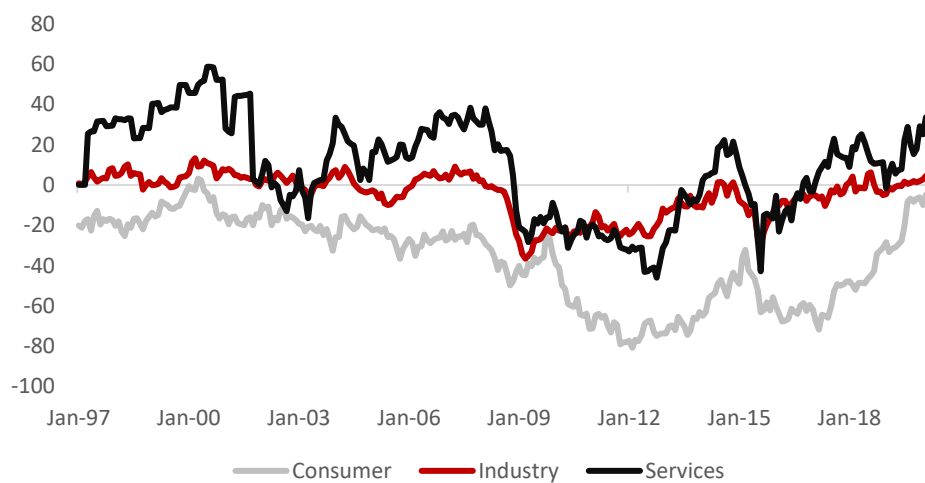
A reduction in public investment typically impacts the economy via two channels. First, it reduces GDP directly through its effect on aggregate demand. Secondly, this affects also supply, through a reduction in the capital stock leading to a permanent reduction in potential output. The large reduction in public investment had large and persistent economic consequences in a country where public investment accounted for nearly 1/3 of overall investment (compared to an average of 1/8 in the OECD countries). The

OECD, for instance, criticized Greece for making drastic cuts in its railway infrastructure. They noticed that the average infrastructure spending on railways declined by 71 per cent between 2000-08 and 2009-15 whereas the average spending on roads fell by less than 10 per cent (OECD, 2018).

Using data from 17 OECD countries between 1985 and 2015, Abiad et al (2016) found that increased public investment raises output, both in the short term and in the long term, crowds-in private investment, and reduces unemployment. They found that those effects depended on several factors including economic slack, public investment efficiency and how public investment was financed.

Because the multiplier for public investment tends to be larger than for other fiscal measures (see for example Abiad et al, 2016), it was thus economically not ideal to focus such a large part of the deficit reduction on public investment. One important consideration with regards to public investment in Greece is that a significant part of the projects was co-financed by the European Union. Between 2010 and 2017, public investment co-financed by the EU accounted for about 8/10 of total public investment. Some of the EU-funded projects were not implemented because of a lack of funding from the Greek-side (Lenoël et al, 2020).

Figure 1: The loss in consumer and business confidence



Source: European Commission

- II. The second issue – partly related to the first one – is the role of confidence in shaping the path that allowed Greece to regain market access. The European Commission confidence indices measuring consumers' confidence of industry and services sectors show that it took about 10 years to restore confidence to levels that prevailed before the financial crisis (Figure 1). Between January 2010 and February 2012, the Greek 10-year government bond yield increased from 6 to 36 per cent. Such a punitive rate illustrated that – despite being for two years in an adjustment programme supported by the IMF, the European Commission and the European Central Bank – financial markets did not expect the Greek government to repay its debt (see also European Commission, 2010a).

The link between risk premium and confidence is well established in the literature. An increase in confidence is generally expected to lead to a decrease of risk premium. For example, Bansal and Shaliastovich (2010) show, using a general equilibrium model, that asset price cycles that do not match real business cycles can be explained by changes in investors' confidence that directly impact the risk premium. Chowdhury (2011) establishes empirically the link between equity risk premium and consumer confidence. The author finds that during the Great Recession, the increase in equity risk premium can be explained by a collapse in consumer confidence. Similarly, Alesina, Prati and Tabellini (1989) explain that a run-on government debt can be a self-fulfilling event where investors lose confidence in the ability of the government to roll over debt, leading to an increase in risk premium and in bond yield, which makes the burden of debt higher for the government and increases again the risk of default and the risk premium paid by investors.

- III. The third issue was the length and the severity of the adjustment. Many economists have argued that the adjustment programme in Greece was too severe (see also Alcidi and Gros, 2019). With a more gradual adjustment spread over a longer period, would Greece have avoided the downward spiral of lower growth and more fiscal consolidation? In economic terms, the debate boils down to whether the fiscal multiplier is higher in the initial part of the adjustment programme or in the later part.

The literature on fiscal multipliers suggests that the fiscal multiplier is generally time and state-dependent. For example, Auerbach and Gorodnichenko (2012) and Bachmann and Sims (2012) estimated spending multipliers to be approximately zero in expansions and as high as 2 or 3 in recessions. Batini et al. (2012) and Jorda and Taylor (2013) suggest that even when achieved during an expansionary period, consolidations can make recessions more likely. From a political point of view, this is particularly relevant for positive but mild-growth periods. Batini et al. (2012) argue that frontloading consolidations during the early stages of a crisis risk to intensify the costs of consolidation itself, thus delaying any efforts of reduction in the debt-to-GDP ratio. To a similar token, Holland and Portes (2012) highlighted the potentially “self-defeating” nature of austerity measures when implemented at unpropitious times, for example, in the presence of liquidity constrained consumers. They showed how aggressive austerity policies could lead in some cases to increases in the debt-to-GDP ratio when the level of GDP declines and that this could have a destabilising impact on sovereign yields and fiscal sustainability.

Monetary policy could in general help alleviate some of the pain of a fiscal contraction. But this tool is not so much available in a currency union. The literature finds that the fiscal multipliers tend to be higher at the Zero Lower Bound (ZLB) (see Christiano, Eichenbaum, and Rebelo, 2011; Eggertsson, 2011; and Woodford, 2011). In the first 4 years of the adjustment programmes, from 2010 to 2014, the ECB interest rates were not at the ZLB. It is only on 10 September 2014 that the main refinancing operations interest rate reached 0.05%, which can be considered ZLB, and it has stayed close to 0 until the immediate aftermath of the COVID-19 shock. According to the argument that the fiscal multiplier is higher at the ZLB, *ex-post* it was preferable to front-load the adjustment before the interest rate reached the ZLB.

2. Literature review

The fact that Greece required three consecutive Economic Adjustment Programmes is a testament of the size and complexity of the adjustment that Greece had to go through.

One strand of the literature looks at the factors that contributed to the emergence of the Greek crisis. Gibson et al (2012) discuss how growing fiscal and current-account deficits led to a financial crisis; whereas, Gibson et al (2014) argues that prior to the financial crisis, markets failed to properly recognised the level of sovereign risk implicit by economic fundamentals such as debt. In that sense, markets failed to recognise the stringency of the Union's 'no-bailout clause', with Greece expected not to pay any premium on borrowing costs over Germany's (see also Macchiarelli, 2016). In this sense, Seyler and Levendis (2015) argue that the *one-size-fits-all* monetary policy set by the ECB was inappropriate for Greece: interest rates were too low for the level of risk of Greek assets, which allowed, for higher inflation rates, excessively low real rates and private sector leverage. Sliad and Maris (2013) also stress that the Greek crisis was also a political one: it had its roots in poor political and governance institutions.

The recession in Greece turned out to be much more severe than expected in the adjustment programmes and the literature is largely critical of how the EAPs were conducted and about their successes. For example, Efthimiadis et al. (2013) assessed the performance of the first programme in terms of potential GDP cost. They estimated through filtering techniques that trend growth rate of GDP in Greece was -3.8 per cent in 2012, against -2.2 per cent, had the targets and forecasts of the first adjustment programme been realized. In a more recent study, Economides et al. (2020) use a micro-founded macroeconomic model calibrated to Greece to study the years of the debt crisis (2008-2016) and, subsequently, the COVID-19 pandemic. Their simulations show that the adopted economic adjustment program, coupled with the observed deterioration in institutional quality can explain most of the cumulative loss in GDP between 2008 and 2016, approximately 23 per cent of GDP. Specifically, the economic adjustment program can explain a fall of around 13 per cent, while the deterioration in property rights accounts for another 10 per cent. Their results suggest

that real GDP dynamics were far worse than those predicted in the initial program, hence undermining potential growth in the medium and long-term.

Besides the quality of institutions, the literature presents a wide range of other reasons why the EAP were not as effective as expected. Mavridakis et al. (2018) highlight factors such as the role of the public sector, clientelist state and the size of the underground economy. Liargovas and Psychalis (2019) argue more fundamentally that the objectives of fiscal consolidation, financial stability and promoting growth and competitiveness were conflicting and could therefore never have been all successful.

Kritikos et al. (2018) believe that the full potential of the private sector has not been fully utilised. They argue that even after the Greek third program, Greek prospects for growth did not improve. They suggest that except for labour market regulations, the conditions for investments and business activities did not change sufficiently through eight years of reform process. They highlight how bulky administrative procedures, slow courts, complicated taxes, and an inefficient knowledge transfer, remain unaddressed: the authors believe that needed economic growth will be impossible to achieve without these reforms.

Pagoulatos (2019) shared similar sentiments. He classified the adjustment programs as 'a failure' and argued that despite the successive reform programs, the Greek economy continued to suffer from a weak public administration, low savings, high consumption, small average business size, and a weak export sector, despite improvements made in all these areas. He did, however, state that public and private deficits diminished substantially, a wide array of structural reforms were implemented, and the administrative capacity of the state improved overall.

In analysing the macroeconomic dynamics of Greece before and during the crisis, Gourinchas et al. (2017) find that Greece's decline in output was significantly more severe and protracted than in the average crisis episode experienced by other countries. They also document evidence that the large drop in output was accompanied by an unusually large drop in the investment-to-output ratio. The authors find that much of the discrepancy can be accounted for by the higher levels of debt that Greece entered the crisis with. Finally, they find that Greece's output drop

at the early stages of the crisis appears to have been one of the main drivers of the fiscal shocks and by the 'sudden stop' of capital experienced by the economy.

Hatgioannides et al. (2018) assessed the composition of the soaring Greek debt and the utilisation of the EU-IMF loans for the 2010-15 period. They provided novel evidence that the majority of the loans went overwhelmingly not to the benefit of a 'profligate state' but rather to avoid the write-downs of bad loans made by German and French banks to the Greek government and Hellenic private banks.

The EAP also appeared to have failed to protect the financial sector from the consequences of the sovereign debt crisis. Kosmidou et al. (2015) analysed, for instance, news reports about the Greek sovereign crisis to test for the impact of the bailout programs on the financial, banking, and real sectors of the Athens Stock Exchange. Their analysis showed that the EAPs' actions caused a shift in the systemic risk of firms in all sectors: in this sense, the Programmes failed to prevent the financial crisis from evolving into a real crisis because of the close link between public and private sectors debt.

Eggertsson et al. (2014) explained the conundrum faced by peripheral euro area countries (Italy, Spain, Greece and Portugal) during the European debt crisis. Structural reforms that increase competition in product and labour markets were identified as the main policy option available for peripheral Europe to regain competitiveness and boost output. Yet, the authors showed that these reforms were inherently deflationary, and with nominal interest rate in the euro area stuck at the zero lower bound, reforms fuelled expectations of prolonged deflation, increased the real interest rate, and depressed aggregate demand. This was particularly the case in Greece.

When it comes to labour markets, the literature seems to be split on the benefits of the labour market reforms as they were implemented in Greece. Tsampra and Sklias (2015), for example, provide a criticism on the memoranda-imposed labour market deregulations, arguing that they led to increased risk of in-work poverty and higher employment precariousness. Other authors, such as Mitsopoulos (2016), argued that

the poor performance of the labour market was explained by other factors and that labour market reforms would pay off in the long-run.

Adam (2020) examined the spillovers from public sector to private sector wages during the Greek economic adjustment programmes. The author found that private sector wages declined as a result of a decline in public sector wages. Karafolas and Alexandrakis (2015) studied instead the regional spillovers, focusing on the unemployment effects of the Greek crisis. They found that regions more specialized in tourism and agriculture were less affected by the crisis than others.

Sovereign debt crisis often led to major economic adjustments, in particular in the labour market, that are difficult to justify with standard economic models. Mitsopoulos (2016) and Tavares (2019) brought to the fore the role of increased taxes to explain the poor performance of the Greek labour market. Tavares (2019) applied the concept of labour wedge, which is the difference between the observed cost of labour and the theoretical cost implied a frictionless model, to explain why Greek employment dropped during the adjustment programmes. The paper showed that the labour wedge deteriorated because government interest rate spreads increased: since external credit was less available, the government needed to rely more on taxation to finance public expenditures and labour tax increased. At the same time, the fact that corporate interest rates also increased provided an additional channel through which firms that were trying to maintain their working capital had to reduce their demand for labour. Mitsopoulos (2016) explains that another effect of higher taxes is to counterbalance the positive effect of lower wage costs on competitiveness. In Greece, exports did not increase despite the push towards an internal devaluation. Yet, the author found that exports of goods that were not facing the increased after-tax energy prices went up during the crisis. In addition, the author argued that labour market reforms that introduced labour flexibility did help stabilize employment, especially among small and medium sized enterprises. The author pointed out that there was much more scope for product market reforms, and that such reforms, combined with a reduction in policy uncertainty had the potential to increase employment and export performance.

Schrader et al (2015) offered a competing explanation: it was Greece's sectoral composition of exports that exhibited a limited growth and value-added potential; such composition was similar to the export patterns of low-income countries due to a focus on raw materials and labour-intensive goods. Esteves and Prades (2018) further explained how a high concentration of exports in a few sectors made the economic adjustment programmes more costly in Greece than in other euro area countries.

Böwer et al (2014) explained that, while Greece has already achieved some improvements in cost competitiveness since the start of the Greek adjustment programme, structural reforms should have also addressed non-cost competitiveness factors, such as the underlying institutional deficits, to unlock Greece's export growth potential.

The literature also highlighted the political economy side of the crisis. For example, Evangelopoulos et al. (2017) explained that the quality of the country's institutions was a key success factor in the adjustment programmes. Had Greece managed to improve the quality of its governance, then – the authors argue – it could have exited its adjustment programmes quicker than it did.

Spanou (2020) analysed whether external pressure by the Troika of the European Commission, the International Monetary Fund and the European Central Bank to reform the Greek economy – i.e., by making loans conditional on structural reforms – did accelerate the pace of reforms compared to what the Greek government would have done without pressure, or whether it slowed down the process instead, by creating mistrust between borrower and lender. The author concluded that external pressure through policy conditionality allowed to implement reforms more quickly, but it did so without creating a political consensus on the necessity of these reforms (see also Lenoël et al., 2020).

3. Description of the counterfactuals and simulations

In what follows we present our analysis focusing on the fiscal consolidation programmes in Greece and ask whether there could have been alternative trade-offs between restoring budget balance and pushing the economy into a recession. This question is mainly answered by building on counterfactual scenarios based on the National Institute Global Econometric Model (NiGEM), which shares many of the desirable features of standard reduced-form multi-country models. In the exercise, several key macroeconomic factors of the adjustment programmes are altered: the composition of public spending cuts, the interaction between fiscal consolidation and confidence, and the length of the adjustment. To achieve these objectives, the presentation of the model needs to remain stylized. The details of the NiGEM model are described in the Annex.

The model is designed to shed light on two sets of issues. First, we want a realistic enough model that allows us to understand which shocks were responsible for the performance of the Greek economy, both before and during of the crisis. Second, we want to use the model to perform some simple counterfactual exercises.

The use of a structural macroeconomic model such as NiGEM is appropriate in the context of an *ex-post* assessment of such an articulated programme given the extraordinary nature of the events unfolding from the 2010 sovereign debt crisis up until recently. While it is not always easy to take into consideration the impact of the political context and other unobservable or exogenous factors (e.g., confidence) as well as other complexities both across space and time, the exercise allows for a much broader range of aspects to be taken into account, which can produce results that are extremely relevant in terms of an *ex-post* analysis.

The choice of the counterfactual scenarios is the result of our analysis of the macroeconomic and fiscal path followed by Greece since the beginning of the first adjustment programme, informed by discussions with the European Commission and other relevant stakeholders (Lenoël et al., 2020). The scenarios are centred around a discussion of the mix between spending cuts and tax increases within the same overall programme budget and a discussion of the sequencing of reforms. The main criteria

for evaluating the programme(s) and their counterfactuals are the path of GDP and the return to debt sustainability.

In calibrating our simulation exercises, we used the results of previous academic research together with available publicly accessible data, reports from the Commission, the ECB and the IMF, information released by the Greek authorities and other international organisations as well as the private sector.

To understand our counterfactual exercises more formally, let $y_{i,t}$ denote the observation of variable i at date t . Let $\hat{y}_i^T \equiv \{\hat{y}_{i,t}\}_{t=0}^T$ denote the estimated sequence for variable i in our sample period for $t = 0$; and y^T denote the sequence of all variables $\hat{y}^T \equiv \{\hat{y}_i^T\}$. Following Gourinchas et al (2017), every estimated sequence can be written as a mapping $\Gamma(\cdot)$ from the calibrated parameters Θ and the sequence of shocks $\hat{\epsilon}_k^T \equiv \{\hat{\epsilon}_{k,t}\}_{k=1,t=0}^{K,T}$ where K is the number of shocks in our model.

$$\hat{y}^T = \Gamma(\Theta, \{\hat{\epsilon}_k^T\}_{k=1}^K)$$

A counterfactual exercise consists in postulating an alternative for $\{\hat{\epsilon}_k^T\}_{k=1}^K$, denoted $\{\tilde{\epsilon}_k^T\}_{k=1}^K$ and then compute the counterfactual \tilde{y}^T as:

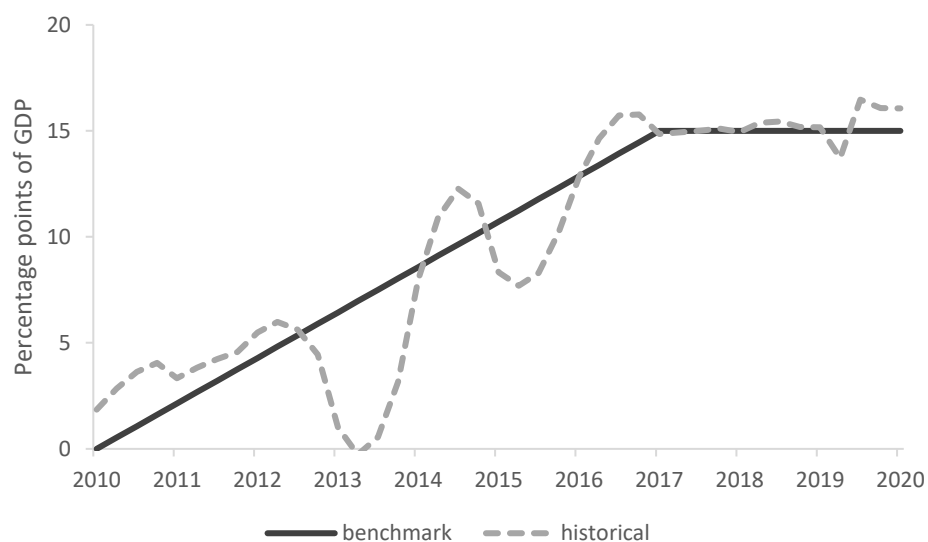
$$\tilde{y}^T = \Gamma(\Theta, \{\tilde{\epsilon}_k^T\}_{k=1}^K)$$

To analyse the role of public investment cuts in the Greek adjustment programmes, we present a simulation of an alternative adjustment programme that would have included less weight on public investment cuts, while achieving the same fiscal consolidation. We assume that government investment would have stayed at the same level as the pre-adjustment programme level, and public consumption would have been reduced more than it was to keep the deficit reduction target unchanged. We, therefore, assume that government investment would be higher by 2 percentage points of GDP than the baseline for 5 years and government consumption lower by the same amount for the same time. The fiscal simulation is therefore expected to be neutral on the deficit.

In a second counterfactual scenario, we assume that Greek risk premium starting from 2010 did not shoot-up as much as it did but instead matched the lower risk premium

of Portugal. The restoration of confidence associated with this lower risk premium could have come from more decisive and coordinated actions by the main stakeholders in the adjustment programme: the Greek government and Parliament committing to adhere strictly to the adjustment programmes and the ECB and other European institutions committing earlier to back Greece and exclude the risk of a ‘Grexit’ scenario. We model the risk premium shock by a reduction in the term premium. The term premium is the amount by which the yield on a long-term bond is greater than the yield on shorter-term bonds. This premium reflects the amount investors expect to be compensated for lending for longer periods.

Figure 2: Fiscal effort expressed as budget balance improvement compared to 2009Q4

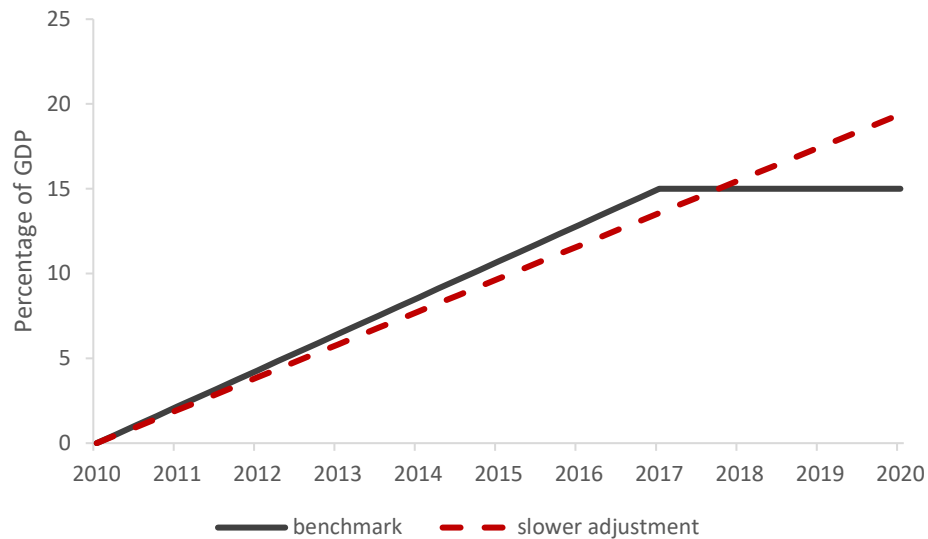


Source: Authors’ calculations based on NiGEM data.

In the third simulation, we study the argument of the length of the adjustment programme in favour of backloading the fiscal adjustment. We run a stylized simulation where the length of the adjustment programmes is extended from 7 to 10 years. The benchmark 7-year period corresponds to the period that it took for the Greek government to return to a positive fiscal balance. After 2016, the fiscal consolidation effort was minimal. Figure 2 shows the fiscal effort expressed as budget

balance improvement since the beginning of the Greek adjustment programme. The full black line corresponds to a smoothed adjustment that we will use as a benchmark for the simulation.

Figure 3: Stylized fiscal effort



Source: Authors' calculations based on NiGEM data.

Our study period encompasses indeed the consolidations from the three consecutive adjustment programmes. We calibrate the 3-year extension so that the total cumulative consolidation as a percentage of GDP is equal to the benchmark case. In the counterfactual of slower adjustment, the yearly consolidation effort is less in the first seven years, but more in the following three years. Figure 3 shows a stylized version of the effort in the two cases. The areas below the full line and below the dashed line are equal by construction, which represents the fact that we keep the envelope of fiscal consolidation equal between the 2 scenarios. Only the distribution of effort across time is altered.

We split the fiscal consolidation effort into direct and indirect tax increases, and cuts in public consumption and investment. Each fiscal shock is defined using the

methodology described above as the difference between the dashed line and the full line. Table 1 below shows the extent of consolidation in each fiscal category.

The Greek model in NiGEM is estimated so that the multipliers correspond to normal times, rather than distressed times. In this sense, our estimates represent a lower-bound of the possible effects, given that at the zero lower bound multipliers are possibly larger. Additionally, the model is solved with expectations being forward-looking. Households therefore know that even though the fiscal stance is accommodative in the first period, it will become contractionary in the second period. As a result, they consume less than if there was no contractionary period to follow and the fiscal multiplier is lower in the first period.

Table 1: Fiscal consolidation by category between 2009 and 2016

Category	Fiscal effort from 2009 to 2016 (percentage of GDP)
Corporate tax	0.4
Household tax	3.1
Indirect tax	7.1
Consumption	3.3
Investment	2.3
Transfers	-2.4
Balance	15.6

Note: a positive (resp. negative) number represents a consolidation (resp. loosening).

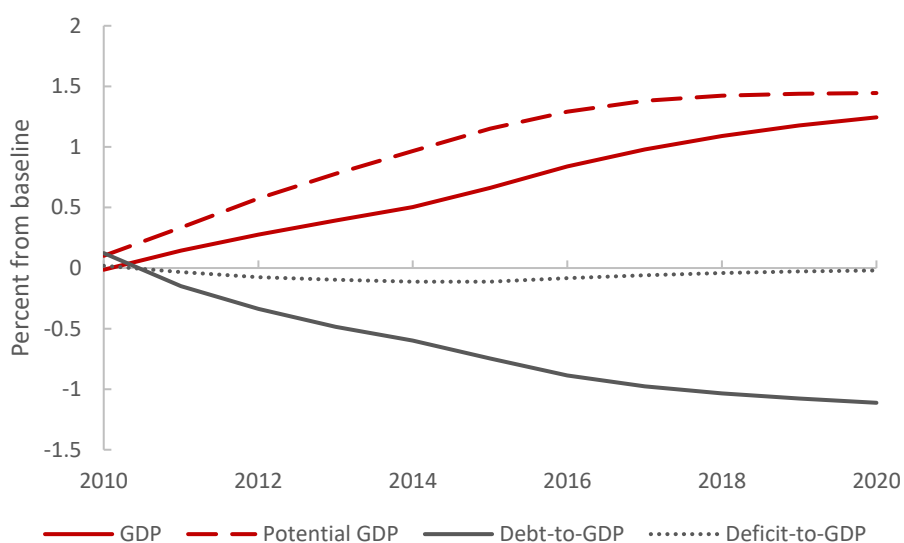
Source: Authors' calculations based on NiGEM data.

4. Results

Figure 4 shows the response of GDP, potential GDP, deficit, and debt to GDP to our simulation of higher public investment and lower public consumption. In the first year, the effects of higher public investment and lower public consumption fully offset each other and the net effect on GDP and the deficit is zero. The increase in public investment is not only a demand shock but also a supply shock which increases the equilibrium level of capital to GDP by reducing the cost of capital in the model, hence improving the economy's potential. Private investment benefited from the lower cost of capital (crowding-in), resulting, at the same time, in potential GDP to increase by up to 1.5 per cent over 10 years compared to the baseline of a no investment increase. As the output gap widens and becomes positive, consumer prices fall, improving households' real disposable income.

Despite the shock being neutral on the deficit-side, debt decreased by 1 percentage points of GDP over the same period thanks to the increase in gross domestic product. While reducing the ratio of debt to GDP by 1 point would have been welcome, the improvement appears tiny compared to the 50 basis points increase observed between 2009 and 2014.

Figure 4: Simulation of higher public investment and lower public consumption



Note: Debt-to-GDP and Deficit-to-GDP are expressed in percentage points from baseline. The shocks are a 5-year increase in public investment by 2% of GDP and a similar size decrease in public consumption.

Source: Authors' calculations based on NiGEM data.

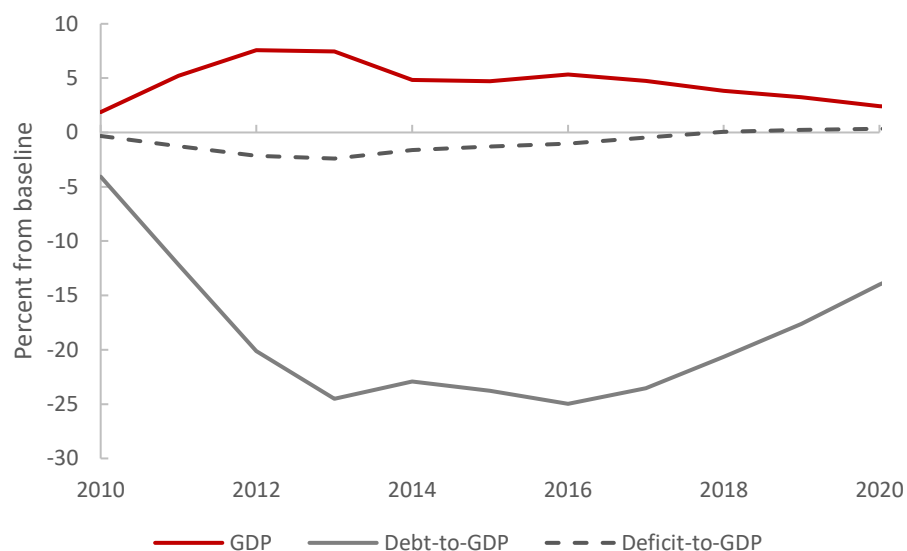
Figure 5 shows the result of the simulation on GDP and the ratios of debt and deficit to GDP under the assumption of a reduction in the Greek term premium. With a lower premium, which we calibrate based on Portugal (or, alternatively, the average euro area country undergoing an adjustment programme over the same period), GDP would have been up to 7.6 per cent higher and the ratio of debt-to-GDP would have been lower by 25 percentage points.⁴ Based on our simulations, the biggest impacts would have been for the year 2012 for GDP and 2016 for the debt to GDP ratio. A lower risk premium would have decreased the user cost of capital and moderated the dramatic fall in investment that occurred in Greece. In fact, private sector investment dropped from EUR 35 billion in 2009 to EUR 14 billion in 2015, equivalent to a fall of 60 per cent. Based on the dynamics observed in the model, the improvement in business confidence would have increased the demand for labour, leading to higher household income and lower unemployment. Consumption would have increased by up to 7 per cent. The demand shock would have initially outweighed the supply shock, resulting in inflation temporarily increasing by up to 1.8 per cent in 2013. But in the long run, the increase in capacity coming from increased investment would have been deflationary and prices would have decelerated to 1.4 percentage point lower in 2020 compared to baseline inflation.

Such a reduction in risk premium would have had lasting consequences on the Greek macroeconomic path following the adjustment programmes. Potential output would have been 5.5 per cent higher after 10 years thanks to the higher level of capital coming from higher investments. figure 6 shows some degree of mean-reversion after

⁴ As a robustness check, we change the assumption of setting the risk-premium to mirror that of Portugal to instead mirror the average risk-premium of other programme countries (Ireland, Portugal plus Spain). Doing so did not change the simulation very much; it would make the gain in GDP slightly bigger and the reduction in debt-to-GDP slightly larger.

2016 when the risk premium returns to the baseline: still, GDP would have been 2 per cent higher and debt 11.5 percentage points of GDP lower after 10 years compared to the baseline.

Figure 5: Simulation of a reduction in risk premium in Greece equivalent to the risk premium of Portugal



Note: Debt-to-GDP and Deficit-to-GDP are expressed in percentage points from baseline. The shock is a decrease in term premium with two troughs, one reaching -14 percentage points in 2012 and the other one reaching -9 percentage points in 2015.

Source: Authors' calculations based on NiGEM data.

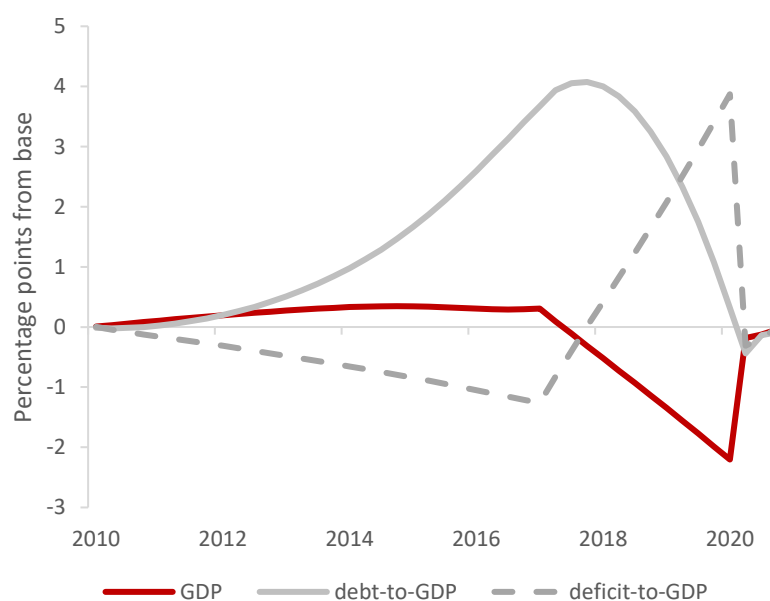
The latter simulation reinforces the message that a key failure of the adjustment in Greece was that authorities underestimated the role of the risk premium, which resulted in a loss of confidence from financial markets. Had the European and Greek institutions intervened earlier and more decisively, we speculate policy uncertainty could have been reduced with a less painful macro-economic adjustment programme overall. For instance, as discussed more broadly in Lenoël et al. (2020), several measures could have shaped expectations towards a more favourable equilibrium such as an (i) earlier debt restructuring (see Alcidi et al. 2020), (ii) an earlier

intervention by the European Central Banks, (iii) a swifter debt sustainability plan among international and Greek authorities. One of the reasons for the high-risk premium in Greece compared to the rest of the EU is the poor quality of its institutions. In this sense, our counterfactual reflects the importance of the quality of the institutions highlighted also in the literature review.

Figure 6 finally shows the result of the simulation of a slower adjustment, moving beyond the standard three-year IMF adjustment programme. In other words, could Greece have benefited from a longer first adjustment programme?

Based on our simulations in NiGEM, one can see that hardly any of the dramatic loss of GDP between 2010 and 2013 is regained. When we do so in the model, the multiplier becomes lower because of the forward nature of expectations, due to Ricardian effects, which dampens the stimulative effect of backloading further the fiscal adjustment. In such a slower adjustment scenario, the fiscal stance becomes much more contractionary between 2017 and 2019, but there is no recovery in GDP growth.

Figure 6: Simulation of a slower adjustment path



Source: Authors' calculations based on NiGEM data.

This simulation shows that imposing a slower adjustment path would probably not have improved the trade-off between fiscal consolidation and GDP growth. It would also not have led to a reduction in the ratio of the Greek debt to GDP. In this sense, changing the length of the time extension does not qualitatively modify the results.

One limitation of the counterfactual exercise of changing the speed of the adjustment is that – in practice – the speed of the adjustment is to some extent endogenous to the adjustment itself. A successful adjustment may take less time than planned and – in the case of Greece – a difficult adjustment took longer than planned. Considering all the factors that may impact the fiscal multiplier, there is no clear-cut empirical evidence that spreading the adjustment over a longer period would have made the adjustment less economically painful. On the contrary, our results support the idea that, had the Greek government announced its plans to balance the budget in a more distant future – for example beyond the tenure of parliament – it could have made the commitment of fiscal consolidation less credible to investors possibly.

We have chosen to study counterfactuals where only one variable in the adjustment programmes is changed each time to understand and insulate the exact effect of each policy decision. Of course, there exist different combinations of policy mixes, including among the three scenarios studied here, which could have maximised GDP growth or minimised the spike in public debt. This would have to be done in an iterative exercise where weights to each counterfactual are changed at each time. For example, one could combine the extension of the length of the adjustment programme with a more moderate cut in public investment. The search for such an ‘optimal policy-mix’ is however beyond the scope of the analysis and certainly represents an interesting avenue for further ex-post considerations on the Greek adjustment path after the sovereign debt crisis.

5. Conclusions

The three Greek adjustment programmes between 2010 and 2018 were ultimately successful in restoring market access and achieving the required adjustment of the economy. However, the initial calibration and focus of the adjustment programmes did not take appropriate account of the specific features of the Greek economy or their social costs. This meant that successive rescue packages were necessary, albeit none of them, proved sufficient alone (for a broader discussion and evaluation see Lenoël et al., 2020).

The reduction in public investment turned out to be much larger and more persistent than planned. Public investment very possibly served as flagship adjustment variable to improve the budget balance rapidly and in a way that was politically attainable, as the government was faced with political pressure to prevent the level of public consumption from decreasing unnecessarily. Based on our first simulation about the demand-side and supply-side effects of a decrease in public investment, we concluded that it was economically *ill-advised* to focus such a large part of the deficit reduction on public investment cuts. A simulation that achieves the same macroeconomic effort, rather skewed on public consumption, shows that Greece potential output would have increased by 1.5 per cent and the debt to GDP ratio reduced over a ten-year horizon. In retrospect, the adjustment programmes should have included a clause carefully ring-fencing public investment that is essential responsible for long-term prosperity of the country.

The adjustment programmes, combined with the intensifying of the sovereign debt crisis, meant it took about ten years for households and businesses to go back the confidence levels observed before the first programme in 2010. Because the public expenditure multiplier was largely underestimated, the government's decision to stop providing some essential services to households and increase taxes, resulted in a much larger than expected economic slump. This led in turns to a higher risk premium, lower productivity and lower household and business confidence.

We also find that the increase in risk premium in Greece, capturing redenomination and country risk, goes a long way in explaining the unexpectedly high cost of the

adjustment. With an overall lower risk premium – which we calibrate based on Portugal (or the average country undergoing an adjustment programme in the euro area) – Greek GDP would have been up to 7 per cent higher and the ratio of debt-to-GDP would have been lower by up to 23 percentage points. We speculate that such a scenario would have been possible had local and international authorities acted in a concerted way sooner, including an earlier last-resort guarantee provided by the ECB through the announcement of the Outright Monetary Transactions (OMTs), which arrived only in 2012. In the case of Greece, the likelihood of a sovereign default increased the government’s funding costs. The government responded largely by cutting public expenditures during the first programme, which exerted a further contractionary effect on the economy. This, in turn, increased the expected costs of default on private-sector loans, causing a rise in non-performing loans and the funding costs for consumers and firms to increase further, putting additional downward pressure on investment, consumption and output.

Finally, we do not find any compelling evidence that a longer adjustment path would have improved the trade-off between GDP growth and fiscal consolidation. We observe that the fiscal consolidation mostly occurred at a regular pace between 2010 and 2016. In a counterfactual of a longer adjustment path, we do not find that the severity of the recession would have been significantly reduced. This is because the fiscal multiplier did not change significantly over the years (against the backdrop of low interest rates and liquidity constrained consumers). This supports the idea that the scale of the required adjustment was evenly and appropriately spread over time.

References

- Abiad, Abdul D Furceri, and P Topalova (2016). The macroeconomic effects of public investment: Evidence from advanced economies. *Journal of Macroeconomics* 50 (2016): 224-240.
- Alcidi, C, A Belke, L Coutinho, A Giovannini and D Gros (2014), State-of-Play in Implementing Macroeconomic Adjustment Programmes in the Euro Area, Policy Note, Directorate General for Internal Policies, Economic Governance Support Unit, European Parliament, Brussels, February, and Economic Policy, CEPS e-book, CEPS, Brussels, March.
- Alcidi C and A Capolongo (2020), Sovereign debt sustainability in Greece during the economic adjustment programmes: 2010-2018, Directorate-General for Economic and Financial Affairs, European Commission
- Alcidi C., and Gros, D. (2019). Public debt and the risk premium, Centre for European Policy Studies, No 2019-06
- Alesina, A., Favero, C. and Giavazzi, F. (2019), 'Austerity: when it works and when it doesn't', Princeton University Press.
- Alesina, A. F., Prati, A., & Tabellini, G. (1989). Public confidence and debt management: A model and a case study of Italy.
- Altavilla C., L. Burlon, M. Giannetti and S. Holton (2019), Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms, ECB Discussion Paper.
- Atinasi, M. G. and A. Klemm (2014). The growth impact of discretionary fiscal policy. ECB Working Paper No. 1697, July 2014.
- Auerbach, A.J., and Y. Gorodnichenko (2012a). Fiscal Multipliers in Recession and Expansion. *Fiscal Policy after the Financial Crisis*, ed. by A. Alesina and F. Giavazzi. (Chicago: University of Chicago Press).
- Auerbach, Alan, and Yuri Gorodnichenko (2012b) Measuring the Output Responses to Fiscal Policy." *American Economic Journal: Economic Policy* 4 (2): 1–27.
- Bachmann, R., & Sims, E. R. (2012). Confidence and the transmission of government spending shocks. *Journal of Monetary Economics*, 59(3), 235-249.

- Balima Hippolyte W. and Amadou N. R. Sy (2019), The Impact of Bailouts on the Probability of Sovereign Debt Crises: Evidence from IMF-Supported Programs, IMF Working Paper WP/19/2
- Bansal R. and Shaliastovich I. (2010) "Confidence Risk and Asset Prices," American Economic Review, American Economic Association, vol. 100(2), pages 537-41, May.
- Barrell, R., Holland, D. and Hurst, I. (2012), "Fiscal multipliers and prospects for consolidation", OECD Journal: Economic Studies, Vol. 2012/1.
http://dx.doi.org/10.1787/eco_studies-2012-5k8x6k5wc58x
- Batini, N., G. Callegari, and G. Melina (2012). Successful Austerity in the United States, Europe and Japan. IMF Working Paper No. 12/190.
- Batini, N., L. Eyraud, and A. Weber (2014). A simple method to compute fiscal multipliers. IMF Working Paper No. 14/93.
- Baum, A., and G.B. Koester (2011). The impact of fiscal policy on economic activity over the business cycle – evidence from a threshold VAR analysis. Deutsche Bundesbank Discussion Paper Series 1: Economic Studies, No. 03/2011.
- Baum, A., Checherita-Westphal, C. and Rother, P. (2012), 'Debt and growth: new evidence for the Euro Area', ECB Working Paper, no. 1450, July.
- Belke A. and D. Gros (2016), Optimal Adjustment Paths in a Monetary Union, CEPS Working Document No. 424/ July
- Belke A and D Gros (2017), Greece and the Troika – Lessons from international best practice cases of successful price (and wage) adjustment, CEPS Working Paper No. 2017/05, May.
- Bergh, A., & Henrekson, M. (2011). Government size and growth: a survey and interpretation of the evidence. *Journal of Economic Surveys*, 25(5), 872-897.
- Blanchard, O. (2015), 'Greece: Past Critiques and the Path Forward', IMF blog 9 July 2015.
- Blanchard, O. and Leigh, D. (2013a), 'Growth forecast errors and fiscal multipliers', IMF Working Papers, WP/13/1, January.
- Blanchard, O. and Leigh, D. (2013b), VoxEU article <https://voxeu.org/article/fiscal-consolidation-what-speed>
- Blanchard, Olivier, and Francesco Giavazzi.(2003) "Macroeconomic Effects of Regulation and Deregulation in Goods and Labour Markets." *Quarterly Journal of Economics* 118 (3): 879–907

- Böwer, U., Michou, V., & Ungerer, C. (2014). The puzzle of the missing Greek exports (No. 518). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.
- Cacciatore, Matteo, Romain Duval, Giuseppe Fiori, and Fabio Ghironi. 2016a. "Short-Term Pain for Long-Term Gain: Market Deregulation and Monetary Policy in Small Open Economies." *Journal of International Money and Finance* 68 (November): 358–385.
- Carnot, N., and F. de Castro (2015). The discretionary fiscal effort: An assessment of fiscal policy and its output effects. *European Economy Economic Paper No. 543*.
- Chowdhury, A. (2011). Do Stock Market Risk Premium Respond to Consumer Confidence? Marquette University College of Business Administration, Working Paper 2011-06
- Checherita, C. and Rother, P. (2010), 'The impact of high and growing government debt on economic growth an empirical investigation for the euro area', *ECB Working Paper series No 1237*, August.
- Corsetti, G., and G.J. Müller (2015). Fiscal multipliers: Lessons from the Great Recession for small open economies. *Swedish Fiscal Policy Council Report 2015/2*.
- Cotarelli, C. and Jaramillo, L. (2012), 'Walking hand in hand: fiscal policy and growth in advanced economies', *IMF Working Papers*, 137, May.
- Christopoulou R and V. Monastiriotis (2014), The public-private duality in wage reforms and adjustment during the Greek crisis, *Research Paper No. 9*, Crisis Observatory
- Economides, G., Papageorgiou, D., & Philippopoulos, A. (2020). Macroeconomic policy lessons from Greece. *Hellenic Observatory Discussion Papers on Greece and Southeast Europe* (152). Hellenic Observatory, London School of Economics and Political Science, London, UK.
- Efthimiadis, T., Papaioannou, S., & Tsintzos, P. (2013). Economic growth in Greece: the cost of a failed adjustment programme. *Applied Economics Letters*, 20(11), 1076-1080.
- Eggertsson, G. B. (2011). What fiscal policy is effective at zero interest rates?. *NBER Macroeconomics Annual*, 25(1), 59-112.
- Eggertsson, G., Ferrero, A., & Raffo, A. (2014). Can structural reforms help Europe?. *Journal of Monetary Economics*, 61, 2-22.
- Esteves, P. S., & Prades, E. (2018). Does export concentration matter in economic adjustment programs? Evidence from the euro-area. *Journal of Policy Modeling*, 40(2), 225-241.

- Evangelopoulos, P., Kouyia, V., & Liargovas, P. (2017). INSTITUTIONS, GROWTH AND THE RECENT ECONOMIC CRISIS: THE EU CASE. *Review of Applied Economics*, 13(1-2).
- Fournier, J. M., & Johansson, Å. (2016). The effect of the size and the mix of public spending on growth and inequality. OECD
- Gibson, H. D., Hall, S. G., & Tavlas, G. S. (2012). The Greek financial crisis: Growing imbalances and sovereign spreads. *Journal of International Money and Finance*, 31(3), 498-516.
- Gibson, H. D., Hall, S. G., & Tavlas, G. S. (2014). Fundamentally wrong: market pricing of sovereigns and the Greek financial crisis. *Journal of Macroeconomics*, 39, 405-419.
- Gourinchas, P. O., Philippon, T., & Vayanos, D. (2017). The analytics of the Greek crisis. *NBER macroeconomics Annual*, 31(1), 1-81.
- Gros, D., Adam, A., Alcidi, C., Belke, A., Lebre de Freitas, M., Moutos, T., Veiga, F. (2015) Expert Study on Export Performance and Internal Devaluation in the Context of a Performance Audit of the Greek Economic Adjustment Programme
- Hantzsche, A., Kara, A., & Young, G. (2019). The economic effects of the UK government's proposed Brexit deal. *The World Economy*, 42(1), 5-20.
- Hatgioannides, J., Karanassou, M., Sala, H., Karanasos, M. G., & Koutroumpis, P. D. (2018). The legacy of a fractured Eurozone: The Greek Dra (ch) ma. *Geoforum*, 93, 11-21.
- Hernandez de Cos, P., and Moral-Benito, E. (2013). Fiscal Multipliers in Turbulent Times: the Case of Spain. Banco de España, Documentos de Trabajo No 1309.
- Holland, D. and Portes, J. (2012), 'Self-defeating austerity', *National Institute Economic Review*, No. 222 October 2012, ppF4 – F10.
- In't Veld, J. (2013). Fiscal consolidations and spillovers in the euro area periphery and core. *European Economy Economic Paper No. 506*, October 2013.
- Ioannides, Y. and Pissarides, C. 'Is the Greek Crisis One of Supply or Demand?', *Brookings Papers on Economic Activity*, Fall 2015, 359 – 373.
- Jordà, Ò. and Taylor, A. (2013). "The Time for Austerity: Estimating the Average Treatment Effect of Fiscal Policy." NBER Working Paper, National Bureau of Economic Research, Cambridge, Massachusetts.
- Kaloziis, P. (2016). Cyprus, Accessing sovereign markets – the recent experiences of Ireland, Portugal, Spain, and Cyprus. *ESM Discussion Paper Series/2*: 50-62.

- Karafolas, S., & Alexandrakis, A. (2015). Unemployment effects of the Greek crisis: A regional examination. *Procedia Economics and Finance*, 19, 82-90.
- Klitgaard, T. & Higgins, M (2014). The balance of payments crisis in the euro area periphery, *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, vol. 20.
- Kosmidou, K. V., Kousenidis, D. V., & Negakis, C. I. (2015). The impact of the EU/ECB/IMF bailout programs on the financial and real sectors of the ASE during the Greek sovereign crisis. *Journal of Banking & Finance*, 50, 440-454.
- Kritikos, A.S., Handrich, L., and Mattes, A. (2018) The Greek private sector remains full of untapped potential, *DIW Weekly Report* 29
- Lenoël. C. (2019). Simulation of French 5-year fiscal plan. *The World Economy*. National Institute Economic Review 242. November 2017 F55-F57. Edited by Graham Hacche
- Lenoël C., Macchiarelli C. and Young G. (2020), The macroeconomic and fiscal path in Greece during the economic adjustment programmes: 2010-2018, European Commission – Brussels.
- Liargovas, P., & Psychalis, M. (2019). Do economic adjustment programmes set conflicting objectives? The case of Greece. *Theoretical Economics Letters*, 9(8), 3065-3087.
- Macchiarelli C. (2016), “European banking union”, *The New Palgrave Dictionary of Economics*. Online Edition. Eds. Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan
- Mavridakis, T., Dovas, D., & Bravou, S. (2018). Failure factors of the economic adjustment programme for Greece. In *Economy, Finance and Business in Southeastern and Central Europe* (pp. 143-157). Springer, Cham.
- OECD (2018), *Economic Survey of Greece*, April 2018.
- Mitsopoulos, M. (2016). Greek export and labor market performance: facts and myths that can help devise a useful growth strategy. In *Stagnation Versus Growth in Europe* (pp. 155-182). Springer, Cham.
- Pagoulatos, G. (2018). Greece after the bailouts: assessment of a qualified failure. *Hellenic Observatory Discussion Papers No. 130*. London School of Economics

- Passas C and C. Pierros (2017), *The Failure of Internal Devaluation and the Case of an Investment-led Strategy to Foster Competitiveness in Greece*, Labour Institute G.S.E.E. Policy Brief / 14
- Pelagidis T. (2014), *Why Internal Devaluation is Not Leading to Export-Led Growth in Greece*, Brookings Blog, September 12
- Perez S. A. and M. Matsaganis (2019), *Export or Perish: Can Internal Devaluation Create Enough Good Jobs in Southern Europe?* South European Society and Politics, Volume 24, 2019 - Issue 2: Policy Reversals in Southern Europe in the aftermath of the Eurozone Crisis
- Petroulakis F. (2017), *Internal devaluation in currency unions: the role of trade costs and taxes*, ECB Working Paper Series, No 2049 / April
- Riera-Crichton, R., C. Veigh, and G. Vultein (2014). *Fiscal multipliers in recessions and expansions: Does it matter whether government spending is increasing or decreasing?* World Bank Policy Research Working Paper No. 6993.
- Schneider, F. (2013). *Size and Development of the Shadow Economy of 31 European and 5 other OECD Countries from 2003 to 2012: Some New Facts*. Available at: https://www.researchgate.net/publication/268185661_Size_and_Development_of_the_Shadow_Economy
- Seyler, E., & Levendis, J. (2015). *What was the role of monetary policy in the greek financial crisis?* South-Eastern Europe Journal of Economics, 11(2).
- Spanou, C. (2020). *External influence on structural reform: Did policy conditionality strengthen reform capacity in Greece?* Public Policy and Administration, 35(2), 135-157.
- Stock, J H., and M W. Watson (2007). *Why Has U.S. Inflation Become Harder to Forecast?* Journal of Money, Credit and Banking 39 (S1): 3–3
- Schrader, K., Bencek, D., & Laaser, C. F. (2015). *Saving Greece Once Again: Have We Reached the Root of the Crisis?* Vierteljahrshefte zur Wirtschaftsforschung, 84(3), 29-45.
- Suni, P. (2014). *A Withdrawal from the euro area: Some Simulation Studies with the NiGEM Model (No. 39)*. The Research Institute of the Finnish Economy.
- Tavares, T. (2019). *Labor market distortions under sovereign debt default crises*. Journal of Economic Dynamics and Control, 108, 103749.

- Tsampra, M., & Sklias, P. (2015). Labor reforms in SEE countries and recovering from the crisis. *Procedia Economics and Finance*, 33, 46-54.
- Uxó, J., Paúl, J. and E. Febrero (2014). "Internal Devaluation in the European Periphery: the Story of a Failure." Working Paper No. 2014/2, University of Castilla – La Mancha, Toledo.
- Wolff, G. (2015), 'Olivier Blanchard fails to recognise two major IMF mistakes in Greece', Bruegel Institute blog.

Appendix: The NiGEM model

The National Institute Global Econometric Model (NiGEM) is a multi-country macro-econometric model linked through trade in goods and services and integrated capital markets. Greece is one of the countries modelled in NiGEM, as are nearly all of the euro area countries. An overview of the model can be found in Hantzsche et al. (2018). NiGEM is particularly fitting for policy analysis because it provides the main characteristics of the main macroeconomic variables, including their dynamics while allowing for the construction of forecasts and counterfactual scenarios. For example, NiGEM was used to simulate the impact of the UK exiting the EU (Hantzsche, Kara and Young, 2019), to evaluate the impact of the fiscal reform package in France under President Macron (Lenoël, 2017) and to simulate the effect of Greece leaving the euro area (Sunj, 2014).

NiGEM uses a 'New-Keynesian' framework in that agents are presumed to be forward-looking, but nominal rigidities slow the process of adjustment to external events. All country models contain the determinants of domestic demand, export and import volumes, prices, current accounts and net assets. In the short run, the dynamic properties of the model are consistent with the data and well-determined. In the long run, output is tied down by factor inputs and technical progress, interacting through production functions. The equations are estimated in equilibrium correction form.

Households in the model are assumed to choose consumption in accordance with life-cycle considerations as a function of their current and expected future real disposable income as well as wealth from housing and financial assets, all net of taxes. In the long run, consumption depends on a dynamic adjustment path around real disposable income and real wealth. Human wealth is a forward-looking component in the consumption model and is defined as a function of the expectations of future real disposable income. The dynamics of adjustment to the long run are data-based and differ between countries to take account of differences in the relative importance of types of wealth and liquidity constraints.

Aggregate supply in the individual country models is based around an underlying constant-returns-to-scale CES production function with labour-augmenting technical

progress. This is embedded within a Cobb-Douglas relationship to allow the factors of production (capital and labour) to interact with energy usage. This relationship underpins the factor demand equations in the model, forms the basis for total unit costs and provides a measure of capacity utilisation, which then feeds into the price system. The prices set by firms depend on the cost of production inputs and a mark-up over the marginal cost. Firms are assumed to choose factors to minimise the cost of production given the production function.

In the labour market, the level of real wages is determined in a bargaining process between workers and firms. The higher the unemployment, the lower is the bargaining power of workers. We assume a Phillips curve relationship between real wage growth and unemployment. Profit maximisation on behalf of firms also requires wages to move in line with productivity over time. Expectations are consistent with model predictions. Nominal rigidities in prices ensure that monetary policy has real effects.

Each country has a set of equations for the public sector. Both direct and indirect taxes depend upon their respective tax bases and on the tax rate. Corporate taxes also depend upon the corporate tax rate and the level of profits, but with lags related to the collection process. Government spending on current goods and services and investment spending depend in part on current plans, and by default rise with trend output. Transfer payments depend upon unemployment and the dependency ratio as well as on policy. Government interest payments are determined by a perpetual inventory model based on the flow deficit and the stock of debt, with the appropriate structure of short and long-term interest payments on the debt stock. A default budget rule is included to ensure that governments stay solvent in the long run, i.e., that the deficit and debt stock return to sustainable levels in all scenarios. The budget rule adjusts the direct tax rate when the public debt-to-GDP ratio or the public budget-to-GDP ratio deviate from their respective targets.

The wealth and accumulation system allow for flows of saving onto wealth and for revaluations of existing stocks of assets in line with their prices determined as above. In the medium term, personal sector liabilities are assumed to rise in line with nominal personal incomes, and if there are no revaluations, gross financial wealth will increase

by the nominal value of net private sector saving plus the net increase in nominal liabilities.

Greek monetary policy in the model is tied to the ECB and can thus be considered as exogenous because it only responds to euro area aggregate shocks.

For completeness, below we detailed the main mechanisms of the model.

Households

Households in the model are assumed to choose consumption in accordance with life cycle considerations as a function of their current and expected future real disposable income as well as wealth from housing and financial assets, all net of taxes. In the long-run, consumption depends on a dynamic adjustment path around real disposable income and real wealth, and follows the pattern discussed in Barrell and Davis (2007).

$$\ln C_t = \alpha^C + \beta^C \ln\{RHW_t\} + (1 - \beta^C)(RTW_t + RNW_t)$$

where C is real consumption, RHW is real human wealth, defined below, RTW is real tangible wealth, mainly housing, and RNW is real net financial wealth.

Human wealth is the forward-looking component in the consumption model and is defined as a function of expectation of future real disposable income as follows:

$$RHW_t = E\left[\sum_{j=0}^T \phi^j RPDI_{t+j}\right]$$

Where $RPDI$ is real personal disposable income, $\phi = \frac{1}{0.25 * \left(1 + \frac{rr}{100}\right)}$, and rr is the short-term real interest rate.

Real interest rate effects are captured by the ϕ parameter in equation (3.1.2). Higher interest rates entail lower current consumption as the opportunity cost of giving up savings is higher. This is similar to an Euler equation, which links the optimal intertemporal consumption decision of a representative consumer with rational expectations to a discount factor and the real interest rate.

The dynamics of adjustment to the long run are largely data based and differ between countries to take account of differences in the relative importance of types of wealth and of liquidity constraints.

Firms

Aggregate supply in the individual country models is based around an underlying constant-returns-to-scale CES production function with labour-augmenting technical progress. This is embedded within a Cobb-Douglas relationship to allow the factors of production to interact with oil usage:

$$Q = \gamma^Q \{ [s^Q (K)^{-\rho} + (1 - s^Q) (Le^{\lambda t})^{-\rho}]^{-\frac{1}{\rho}} \}^\alpha M^{1-\alpha}$$

where Q is real output, K is the total capital stock, L is total hours worked, λ is the rate of labour-augmenting technical progress and M is oil input.

This relationship underpins the factor demand equations in the model, forms the basis for unit total costs and provides a measure of capacity utilization, which then feeds into the price system. Demand for labour and capital are determined by firms' profit maximisation, implying that the long-run labour-output ratio depends on real wage costs and technical progress, while the long-run capital output ratio depends on the real user cost of capital

$$\ln L = \alpha_1^L + \ln Y - (1 - \sigma^L)\lambda t - \sigma^L \ln\left(\frac{w}{p}\right)$$

$$\ln K = \alpha_2^K + \ln Y - \sigma^K \ln\left(\frac{c}{p}\right)$$

where α_1^L and α_2^K are constant terms related to the other parameters in the model, w/p is the real wage and c/p is the real user cost of capital.

Barrell and Pain (1997) estimate an elasticity of substitution σ^L of 0.5 from the labour demand equation. The user cost of capital depends on the real long-term interest rate and a risk premium.

Business investment is determined by the error correction-based relationship between actual and equilibrium capital stocks as below.

$$IB_t = K_t - K_{t-1} * (1 - \text{dep})$$

where IB is business investment, K is the capital stock, dep is the depreciation rate and the long run equation for the capital stock is (3.2.3)

Governments

The government budget deficit is:

$$BUD = CED * (GI + GC) + TRAN + GIP - TAX - CTAX - ITAX$$

where the government budget deficit (BUD) is determined by spending minus revenues. Government spending includes spending on investment (GI) and consumption (GC) rising in line with trend output in the long run, with delayed adjustment to changes in the trend. They are re-valued in line with the consumers' expenditure deflator (CED). Besides transfers (TRAN) to unemployed and pensioners as well as interest payment (GIP) depending on the size of the accumulated debt and the prevailing interest rate are identified. The revenues include corporate (CTAX) and personal (TAX) direct taxes and indirect taxes (ITAX) on spending.

The deficit flows onto the debt stock, which affects interest payments and private sector wealth.

$$DEBT_t = DEBT_{t-1} + BUD_t - \Delta M_t$$

A budget rule is included to ensure that governments stay solvent in the long run, i.e. that the deficit and debt stock return to sustainable levels in all scenarios. The budget rule adjusts the aggregate tax rate when the public debt ratio (GBR) deviates from its target ($GBRT$) as below:

$$taxr_t = taxr_{t-1} \left[\frac{0.01 * y_{t-1} (py_{t-1} / 100) * (\beta^{taxr} (gbrt_{t-1} - gbr_{t-1}))}{pi} \right]$$

Where $taxr$ is the tax rate, y is GDP and py is the GDP deflator and pi is personal income.

This entails that if the government budget deficit is greater than the target, then the income tax rate adjusts upwards to return the deficit to target in the medium-term (a time span of around 5 years).

Monetary policy authority

The monetary policy authority in the model operates predominantly through the setting of the short-term nominal interest rate. This is done with reference to a simple feedback rule depending on inflation, the output gap, the price level, and nominal output. Different monetary policy rules are defined, with the two-pillar strategy being the default one.

The Two-Pillar strategy defines the short-term real interest rate as a function of the ratio of the nominal GDP target to nominal GDP and the difference between inflation expectations and the inflation target.⁵

$$i_t = \gamma^i i_{t-1} + (1 - \gamma^i) \left[-\alpha^i \ln \left(\frac{NOM^*_t}{NOM_t} \right) + \beta^i (inf_{t+1} - inf^*_{t+1}) \right]$$

Where i is the short-term nominal interest rate, NOM is nominal output, NOM^* is a specified target for nominal output, inf is inflation expectations ($= \Delta CED_{t+1}$) and inf^* is the inflation target; $\gamma^i = 0.5$.

Prices of goods and services

The prices set by firms depend on the cost of inputs to production. Firms are assumed to choose factors to minimise the cost of production given the production function. Substituting optimal factor input levels into the cost function (and abstracting from energy inputs into production) yields an expression for total costs:

$$TC = W\bar{L} + r\bar{K} = \frac{Q}{\gamma^Q} \left\{ s^{Q\frac{1}{1+\rho}} r^{\frac{\rho}{1+\rho}} + (1 - s^Q)^{\frac{1}{1+\rho}} W^{\frac{\rho}{1+\rho}} (e^{-\rho\lambda t})^{\frac{1}{1+\rho}} \right\}^{\frac{1+\rho}{\rho}}$$

Assuming that firms operate on demand curves for factors in the long run, \bar{L} and \bar{K} , we derive an expression for the marginal cost of production:

⁵ Nominal GDP is determined by the GDP deflator by default, but it is also possible to use a consumer expenditure deflator.

$$MC = \left(\frac{\bar{L}}{Q}\right)^{1+\rho} (\gamma^Q e^{\lambda t})^\rho \frac{W}{(1-s^Q)}$$

Under imperfect competition, firms charge a mark-up over the marginal cost. The assumed market structure is similar to the standard assumption of monopolistic competition but not identical to it, allowing for more flexibility and institutional differences across countries.

Consumer prices in the model are a function of unit total cost and a wedge explained by prices of imported goods and services:

$$\ln CED = \beta_1^{CED} \ln UTC + \beta_2^{CED} \ln PM$$

Parameter β_2^{CED} captures the sensitivity of consumer prices, and inflation, to price pressure from abroad and depends on the openness of the economy and demand for imports.

Short-term expressions for all price equations are written in error correction form, such that the growth rate of unit total cost, $\Delta \ln UTC$, also depends on lagged differences of wages $\ln W$ and lagged technological change. Consumer price inflation is also a function of lagged unit total cost growth, and import price inflation.

Wages and unemployment

Wage bargaining

In equilibrium, the level of real wages is determined in a bargaining process between workers and firms. The higher unemployment, the lower is the bargaining power of workers. We assume a Phillips curve relationship between real wage growth and unemployment. Profit maximisation on behalf of firms also requires wages to move in line with productivity over time. We therefore allow for an error correction of wages to trend labour productivity as well deviations of actual labour productivity from trend. The productivity-augmented real wage Phillips curve is written as:

$$\Delta \ln \frac{W_t}{CED_t} = \beta_1^w U_{t-1} - \delta^w \left[\ln \frac{W_{t-1}}{UTC_{t-1}} + b_1^w \left(t_{t-1} - \ln \frac{Q_{t-1}}{L_{t-1}} \right) - b_2^w \ln \frac{Q_{t-1}}{L_{t-1}} \right]$$

$\frac{W_t}{CED_t}$ is the real consumer wage and U_{t-1} the lag of the unemployment rate. $\frac{W_{t-1}}{UTC_{t-1}}$ is the real producer wage, $\ln \frac{Q_{t-1}}{L_{t-1}}$ is realised (log of) output per hour worked, i.e., labour productivity, and $\left(t_{t-1} - \ln \frac{Q_{t-1}}{L_{t-1}} \right)$ the deviation of (log) labour productivity from long-run productivity trend.

Parameters β_1^w and δ^w vary across countries and reflect differences in labour market institutions that determine the bargaining power of workers relative to firms, such as union density, unemployment insurance, employment protection and minimum wages (Table 3).

Expectations

While workers and firms base their economic decisions on real wages, in practice nominal wages are bargained over. Rational agents not only take into account the current price level but also form expectations about the price level in the future. We account for the forward-looking nature of nominal wage setting as follows:

$$\Delta \ln W_t = \alpha_0^w \Delta \ln \frac{W_t}{CED_t} + \alpha_1^w \Delta \ln CED_t + \alpha_2^w E[\sum_{h=1}^H \Delta \ln CED_{t+h}]$$

W_t is the nominal wage. CED_t is the current price level (consumer expenditure deflator), itself a function of unit total costs of production, consumption tax rates and import prices. $E[\sum_{h=1}^H \Delta CED_{t+h}]$ is expected inflation over H periods. Expectations are consistent with model predictions.

Parameters α_1^w and α_2^w govern the extent to which agents are forward-looking, or ‘rational’. $\alpha_2^w = 0$ would imply that expectations are formed purely adaptively. In NiGEM, such a parameter setting is optional. $\alpha_1^w \neq 0$ implies that expectations about the price level are sticky and allows us to account for nominal rigidities. This can be compared to approaches in the DSGE literature to model nominal rigidities, such as the concept of Calvo pricing (Calvo, 1983; e.g., Christiano et al., 2005). By contrast, our method is more strongly motivated by empirical considerations (fitting the data), and parameters α_1^w and α_2^w vary across countries. Like DSGE-type models, nominal rigidities in NiGEM ensure that monetary policy has real effects.

Equilibrium rate of unemployment

In equilibrium, actual inflation equals expected inflation and capacity utilisation will settle at an equilibrium. In addition, actual labour productivity and labour-augmenting technological progress should grow at the same rate. The equilibrium rate of unemployment can then be written as a function only of structural parameters, the terms of trade (export relative to import prices, $\frac{PX}{PM}$) and domestic producer price inflation relative to imported inflation to allow for global current account imbalances in the long run

$$U^* = \alpha_1^U + \alpha_2^U \Delta \ln \frac{PX}{PM} + \alpha_3^U \Delta \ln \frac{UTC}{PM}$$

where α_1^U captures the parameters associated with product and labour market institutions in the price and wage setting equations. If α_3^U was zero, this would imply that the equilibrium unemployment rate would only be determined by structural factors and the terms of trade.

U^* can also be interpreted as the non-accelerating inflation rate of unemployment (NAIRU): it indicates the level of unemployment below which inflation would be expected to rise relative to expectations.

From the equilibrium rate of unemployment, the equilibrium level of employment can be derived:

$$L^* = LF(1 - U^*)$$

(4.2.4)

where LF is the labour force. The size of the labour force depends on demographics, migration and participation rates. We take it as exogenously given, using projections from official sources. With respect to employment, we further distinguish between employees in employment and the self-employed. Only the former is assumed to be relevant for the wage and price setting process.

International trade

NiGEM is a globally closed model in that all income and asset flows into one country are matched by outflows from other countries. International trade is driven by

demand such that no country exports unless there is demand from other countries. Import demand is modelled as a function of total final expenditure and import price competitiveness:

$$\Delta \ln M_t = \beta_0^M + \beta_1^M \Delta \ln TFE_t - \beta_2^M \Delta \ln \frac{PM_t}{CED_t} - \delta^M \left[\ln M_{t-1} - b_1^M \ln TFE_{t-1} + b_2^M \ln \frac{PM_{t-1}}{CED_{t-1}} \right]$$

Total final expenditure TFE_t is defined as domestic demand less imports.

Import price competitiveness is defined as the ratio of import prices over domestic prices: the higher the price of imports relative to prices at home, the lower import demand. Import prices are a weighted average of prices for commodity and non-commodity imports

$$PM = \alpha^{PM} PM^{COM} + (1 - \alpha^{PM}) PM^{NCOM}$$

Commodity import prices PM^{COM} are exogenously given prices for metal, agricultural raw material, food, beverages and fossil fuel. In the long run, the growth rate of these prices is determined by the growth rate non-commodity prices. α^{PM} is a country's share of commodity exports in total exports. Non-commodity import prices PM^{NCOM} of country i are a weighted average of other countries' export prices PX_j^{NCOM}

$$PM_i^{NCOM} = \sum_{j=1}^J w_j PX_j^{NCOM}$$

where weight w_j is the share of country j 's exports in all imports of country i and J is the number of trading partners.

Non-commodity export prices are written in error correction form to converge to an equilibrium defined by competitors' export prices and the domestic price level:

$$\Delta \ln PX_{it}^{NCOM} = \beta_0^{PXN} - \delta^{PXN} \left[\ln PX_{it-1}^{NCOM} - b_1^{PXN} \ln CPX_{it-1}^{NCOM} - b_2^{PXN} \ln \frac{CED_{t-1}}{RX_{t-1}} \right] + \beta_1^{PXN} \Delta \ln \frac{CED_t}{RX_t} + \beta_3^{PXN} \Delta \ln DPX_{it}^{NCOM}$$

Competitors' export price level is defined as the average of export prices of competitors l in a particular market, weighted by the presence of competitors in that market v_l :

$$CPX_i^{NCOM} = \sum_{l=1}^L v_l PX_l^{NCOM}$$

In the short run, export prices not only depend on domestic price inflation but also export competitors' domestic prices. These are defined as average domestic prices weighted by exports from country i to country m relative to total exports from country i

$$DPX_i^{NCOM} = \sum_{m=1}^M u_m \frac{CED_m}{RX_m}$$

Putting import demand and relative price levels together allows us to write the dynamic export equation as follows:

$$\Delta \ln X_{it} = \beta_0^X - \delta^X \left[\ln X_{it-1} - \sum_{n=1}^N r_n \ln M_{nt-1} - b_1^X \ln \frac{PX_{it-1}^{NCOM}}{CPX_{it-1}^{NCOM}} - b_2^X \ln \frac{PX_{it-1}^{NCOM}}{DPX_{it-1}^{NCOM}} \right] + \beta_1^X \Delta \sum_{n=1}^N r_n \ln M_{nt} + \beta_2^X \Delta \ln \frac{PX_{it}^{NCOM}}{CPX_{it}^{NCOM}} + \beta_3^X \Delta \ln \frac{PX_{it}^{NCOM}}{DPX_{it}^{NCOM}}$$

In the long run, export volumes are tied down by foreign demand and the competitiveness of export prices relative to export prices of competitors and trading partners' domestic prices, with short run adjustments made with respect to changes in the same variables. Slopek (2018, this Review) explores the role of tariffs in shaping the relationship between export prices and foreign demand for exports. He finds that assumptions made about the adjustment of export prices can have important implications for the adjustment of the economy to the introduction of tariffs.

The trade balance is calculated as export volumes less import volumes

$$TB_t = \frac{X_t}{RX^b} \frac{PX_t}{PX^b} - \frac{M_t}{RX_t} \frac{PM_t}{PM^b}$$

where superscript b indicates a variable's base year value.

Financial market prices

Like product markets, international financial markets clear such that global liabilities equal global assets. A country's net income from interest payments, profits and dividends (IPD) can be written as the difference between income credit and debit

$$(IPDC_t - IPDD_t) = [ROR_t(GA_{t-1} - \beta_1^{IPD}GL_{t-1}) + i_t^*\beta_2^{IPD}GL_{t-1}] - \left[\beta_3^{IPD}(PROF_t - TAX_t^c) + \left(1 - \frac{0.2}{debt_t^{gov}/y_t}\right)INT_t^{gov} + \frac{GL_{t-1}RX_{t-1} - \left(1 - \frac{0.2}{debt_t^{gov}/y_t}\right)debt_{t-1}^{gov} - \beta_4^{IPD}EQCAP_{t-1}EQPR_t}{RX_t} \right]$$

The terms in the first bracket represent credit with the rest of the world. GA are gross assets held, and GL are gross liabilities, which are both assumed to be a proportion of nominal GDP. ROR is the rate of return on foreign assets, which error-corrects in world debit. i_t^* is the short-term interest rate earned on liabilities in the rest of the world. We assume it to be identical to the US risk-free rate (policy rate).

The second bracket contains debit with the rest of the world. It is written as a function of profits less corporate taxes, interest payments on government debt and private and government debt as well as stock market returns expressed in domestic currency.

The current account balance is the sum of the trade balance, net foreign income and balance of payments transfers, the latter defined as being proportional to nominal GDP in foreign currency terms $BPT_t = \beta_1^{BPT} \frac{y_t p_t^y}{RX_t}$, with p_t^y being the GDP deflator:

$$CB_t = TB_t + (IPDC_t - IPDD_t) + BPT_t$$

Prices on international financial markets, i.e. long-term interest rates, exchange rates and equity prices, adjust in a forward-looking manner while allowing for (small) deviations from a standard no-arbitrage condition.

Short-term interest rates i_t are determined by the monetary policy rules described in section 3.4 thereby responding endogenously to the state of the economy. Long-term interest rates LR_t result from a 10-year forward convolution of short-term rates plus

a term premium, which may capture risks associated with uncertainty about future monetary policy, bond market liquidity, or sovereign default:

$$(1 + LR_t) = \prod_{h=0}^{10} (1 + i_{t+h}) + TPREM_t$$

The bilateral exchange rate RX_t , defined as domestic currency per unit of foreign currency. It is forward-looking in that it jumps in response to news about the expected path of interest rates, solving an uncovered interest parity condition:

$$RX_t = RX_{t+1} \left(\frac{1+i_t}{1+i_t^*} \right)$$

Finally, equity prices move with discounted future values of profits relative to private sector capital stock KP plus a premium:

$$EQP_t = \frac{PROF_t - TAX_t^c}{KP_t} + \frac{EQP_{t+1} KP_{t+1}}{(1+i_t)(1+EQPREM_t)KP_t}$$

The equity risk premium drives a wedge between returns on equity and returns on interest-bearing debt.