Probabilistic assessment of external sustainability in Portugal

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Abstract

Portugal is one of the most externally indebted economies in the eurozone. The deeply negative net international investment position (NIIP) suggests that large current account surpluses will be needed in the future to restore external sustainability. Despite significant interest in the scope for external adjustment within a monetary union, little is known about the magnitude or likelihood of the relative price change required to facilitate this adjustment. Drawing on a new probabilistic framework of external sustainability, this paper estimates the likelihood that a real effective depreciation is needed to lower Portugal's net external liabilities to more prudent levels. Contrary to conventional thinking, we find that the NIIP is sustainable without real depreciation with fairly high probability, estimated between 32 and 43 percent. We highlight the predominance of financial account shocks over current account shocks in this assessment. To provide context to the assessment, we also apply the framework to Ireland. Despite a weaker NIIP than in Portugal, the probability that the external position is sustainable in Ireland is higher, estimated between 54 and 60 percent, predominantly reflecting forecasts of large and sustained trade surpluses.

Keywords External sustainability · External adjustment · Current account adjustment · Internal devaluation · Currency union

JEL F4 · F32 · F34 · F45 · F47

1 Introduction

Following entry into the eurozone, Portugal's net international investment position (NIIP) deteriorated rapidly. In 1999, Portugal's NIIP was -34 percent of GDP; by end 2018 it stood at -106 percent. This places Portugal's net external liabilities as the fourth weakest among the 19 members of the eurozone as well as the larger

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27-member European Union (EU). In November 2017, the European Commission (EC) identified Portugal's NIIP as one of the main drivers of its excessive macroeconomic imbalances, noting that it lay significantly beyond the Commission's country-specific prudential threshold of -48 percent of GDP (European Commission 2017).

As a key state variable of the macroeconomy, the deeply negative NIIP suggests that Portugal will need to generate large current account surpluses for a sustained period in the future to achieve external sustainability. Even though Portugal has recently engineered a reversal from large current account deficits to intermittent current account surpluses, the size of the NIIP in relation to the economy suggests that the scale and duration of this external adjustment may be substantial, with domestic absorption below domestic production for some time. This has raised concerns about the output and employment costs of the adjustment, which has relied to some extent on the compression of demand to raise the trade balance, and labor shedding to lower unit labor costs (Pisani-Ferry 2013; Belke (2017); Kang and Shambaugh 2016).

The purpose of this paper is to undertake an analytical assessment of external sustainability in Portugal. Drawing on a new framework to assess external sustainability by Blanchard and Das (2017), the paper quantifies the real effective exchange rate (REER) depreciation required to raise the NIIP to a range of indicative thresholds and estimates the probability that the external position is sustainable. When stocks of foreign assets and liabilities are large, as they are in Portugal, even small shocks to the expected rates of return on these holdings can generate large valuation changes. These valuation changes, in turn, can result in strong stabilizing or destabilizing dynamics of the NIIP. In contrast with the textbook approach, this framework permits external adjustment to come from both future net exports (the traditional "trade channel"), as well as a new "financial channel" that gives a role to the rates of returns on foreign assets and liabilities.

While there has been significant interest in the scope for external adjustment in a currency union, I am aware of no work that has quantified the magnitude or likelihood of the relative price change required to facilitate this adjustment. Given its high external indebtedness, this makes Portugal an interesting case to analyze. While a few other countries in the eurozone are more indebted than Portugal, some are infeasible to analyze due to short historical data series (e.g. Cyprus) while others have still limited access to global capital markets (e.g. Greece).¹ Although an in-depth analysis of Ireland, currently the highest net debtor in the European Union, is not within the scope of this paper, I apply the sustainability framework to Ireland to provide context to the results for Portugal.

The main findings are as follows. To achieve external sustainability over a horizon of fifteen years, Portugal requires a real effective depreciation of about 7 percent for an adjustment that raises the NIIP to -95 percent of GDP, while a larger adjustment to -60 percent of GDP requires a depreciation of about 16 percent. The

¹ As noted in Guscina et al (2017), limited market access can affect the sustainability of debt (through interest rates and the structure of borrowing). Simultaneously, investor perceptions about the sustainability of debt can affect market access. The circularity of this relation complicates the interpretation of sustainability.

magnitude of the required depreciations reflects forecasts of low net exports, rates of return on foreign liabilities which exceed those on foreign assets, and a low revaluation response of the NIIP to exchange rates due to the small foreign-currency shares of foreign assets and liabilities. The probability that the external position in Portugal is sustainable ranges from 32 to 43 percent. Drawing on the historical evidence that financial account shocks in Portugal are much larger than trade shocks, ignoring the financial channel of adjustment results in overstating the probability that an exchange rate depreciation is required to achieve external sustainability.

The deterministic calculations indicate that, despite a weaker NIIP, a real effective depreciation is not required for external sustainability in Ireland. This results from forecasts of large and sustained trade surpluses which more than offset the forecast of the large net outflows of income associated with the higher rates of return on foreign liabilities relative to foreign assets. Nevertheless, accounting for the uncertainty of forecasts, the probability that Ireland's external position is sustainable is not one but ranges from 54 to 60 percent.

Empirical assessments of external sustainability depend on forecasts of the trade balance and, with the new methodology, also on forecasts of the rates of return on external assets and liabilities. For this paper, all results are obtained using IMF forecasts which were made in October 2019. The probabilistic assessment uses historical data to create bounds around these IMF forecasts. Both the deterministic and probabilistic results could differ if forecasts from other sources were different from IMF forecasts. In that case, even though the bounds created by the historical data would not differ, they would be centered around a potentially different value that affects the probabilistic assessment.

Finally, it bears mentioning that this paper was written before the Covid-19 pandemic. Since then, not only have the data affecting debt dynamics changed significantly in Portugal and many other countries, but to some extent so have economists' notions about debt and indebtedness. To that end, an assessment of external sustainability in Portugal in 2018 may be fairly disconnected from the revised outlook for the country. Nevertheless, as this paper also illustrates a new methodology and emphasizes the role of factors other than just the trade balance in external sustainability analysis, the underlying findings of this paper still hold and could be even more important going forward. The remainder of the paper is organized as follows. Section 2 gives an overview of the challenges of external adjustment in Portugal. In Sect. 3, I describe the characteristics of the external position in Portugal that are likely to shape the external adjustment. Section 4 reviews the external sustainability framework used in this paper. Section 5 presents the results of the analysis for Portugal and comparative results for Ireland. Section 6 concludes.

2 Challenges of external adjustment in Portugal

One of the significant features of the external adjustment in Portugal is that it will take place in the context of a monetary union. This implies that the policy options available to help the adjustment are significantly limited by the absence of

Fig. 1 Labor market developments in Portugal (1996–2018)

independent monetary policy, the inability for external devaluation, and constraints to fiscal policy from EU agreements in the Stability and Growth Pact.

It has been broadly recognized that to restore external balance Portugal will need to raise demand for its exports, and steer domestic spending from imports towards domestically-produced goods.² In turn, this will require improvements in both non-price and price competitiveness. Improvements in non-price competitiveness will depend inter alia on structural reforms that lower rigidities in its labor, product and financial markets (Reis 2015). With exchange rate devaluation option off the table, improvement in cost competitiveness will need to come via slower growth in prices and unit labor costs (ULC) relative to trading partners; that is, internal devaluation. This however poses challenges as some of Portugal's euro area trading partners are seeking internal devaluation themselves.

Insofar as internal devaluation can be achieved by falling prices in Portugal rather than rising prices in trading partners, there are two key risks from the adjustment. One is that, given downward wage rigidity, unemployment may need to rise in order to put downward pressure on wages (Barattieri 2014). If this were to happen, a strategy of internal devaluation could jeopardize internal balance in the pursuit of external balance.

The evolution of unemployment rates indicates that between 2009 and 2014 this risk may have already materialized (Fig. 1). Although the unemployment rate has since fallen from 16 percent in 2013 to 6.8 percent in 2018, this development too must be viewed against two trends. One is the high degree of emigration from Portugal, which has had a favorable impact on the unemployment rate as emigrants are mainly of working-age (O'Rourke 2015).³ The second is the rising share of full-time employment at minimum wage, which has climbed from 8 percent in 2009 to over 22 percent in 2018.

² For a discussion of issues relevant to external adjustment in Portugal see, e.g., Blanchard (2007), Reis (2013, 2015), O'Rourke (2015), Dias, Marques and Richmond (2016), Matos, Menezes and Nunes (2018), Blanchard and Portugal (2017). A broader literature on adjustment in southern European economies includes Belke and Gros (2016), Shambaugh (2012), Wasmer (2012), Decressin et al (2015), Alcidi et al (2016).

³ Recent data indicate that net migration through 2018 remain negative (Instituto Nacional de Estatística 2019).

Fig. 2 Measures of Competitiveness in Portugal

The second risk is that internal devaluation could be deflationary, which could lower domestic demand more than the gains from higher exports, and thus induce a debt-deflation spiral (Decressin et al. 2015). This would make the burden of the NIIP as a share of national income more onerous.

Given such risks, two interrelated relative price adjustments will be central to achieving both internal and external balance. One involves lowering domestic tradable prices vis-à-vis foreign tradable prices. Such a relative price change can be facilitated by lowering production costs (including wages) and improving non-price competitiveness vis-à-vis trading partners. The second adjustment involves raising the relative profitability of tradables to reorient productive resources towards the tradable sector. This can be achieved by lowering tradable sector ULCs vis-à-vis the non-tradable sector (see Das and Korniyenko 2018).

The challenges in achieving these competitive gains will not be trivial. Consider the evolution of Portugal's competitiveness shown in Fig. 2.⁴ After rising 10 percent from 1996 to its peak in 2006, the REER based on ULCs erased that increase by 2015 and is now some 3 percent above its 1996 level.

This suggests large productivity improvements, but it presents an incomplete picture. Kang and Shambaugh (2016) report that through 2014, the gains in ULCs were derived largely from labor shedding as wages continued to rise. Moreover, ULCs are predominantly calculated using tradable sector prices (Ahn et al. 2017; Amador and Soares 2013). Stagnant productivity in Portugal, however, has been linked to the misallocation of foreign capital to unproductive firms in the nontradable sector (see Reis 2013; Amador and Soares 2013). By some accounts, this resource misallocation shaved as much as 1.3 percentage points of output growth annually during 1996–2011 (Dias et al. 2016). The REER using the broader economy-wide CPI shows less pronounced improvements, consistent with more modest competitiveness gains.

⁴ The REER is a weighted average of bilateral real exchange rates with weights proportional to the volume of trade flows with trading partners and adjusted for differences in price levels with each partner. While the CPI is often used for adjusting the price level, unit labor costs (ULC) are also used at times, as are GDP deflators.

It has been suggested that further adjustment of relative prices, without risking a rise in the unemployment rate, should be derived from an improvement in productivity (Blanchard and Portugal 2017). In this context, structural reforms have been advanced as an important avenue to raise productivity and productivity growth. Reversing the misallocation of resources will also be an important element of this effort. An important concern, however, is that structural reforms take time to implement and may have a limited impact over the short term (OECD 2012). Indeed, nearly 500 distinct reforms of the labor market, product market, public sector and the financial sector were instituted as part of the IMF adjustment program (Reis 2013; IMF 2015). Comprehensive evidence of their impact on productivity is yet to be documented.

Having discussed the challenges for external adjustment in Portugal, I now give an overview of its key external sector characteristics.

3 The external position in Portugal

The external adjustment in Portugal will be shaped by several factors. To put the empirical results in context, I give an overview of the most relevant ones: the composition of the NIIP by financial instrument; the composition of the current account; and the rates of return earned on foreign assets and liabilities. I begin with a review of the composition of the current account and the stock-flow process underlying the dynamics of the NIIP.

The current account balance is the sum of three accounts: the trade balance, the primary income balance, and the secondary income balance (Appendix Table A1).⁵ The trade balance records the difference between the exports and imports of goods and services. The primary income balance records the difference between factor income received from, and paid to, the rest of the world. Its two main categories are “net investment income”, which records the net income associated with external financial holdings (e.g. dividends and interest payments), and net compensation to employees.⁶ Finally, the secondary income balance records the difference between transfers received from, and those paid to, the rest of the world.⁷ These include cash and in-kind transfers, but exclude capital transfers which are recorded in the capital account.

Consider a standard law of motion for the NIIP (e.g. Schmitt-Grohe and Uribe 2017):

$$N_{t+1} = N_t + CA_t + KA_t + VAL_t \quad (1)$$

⁵ The sixth edition of the Balance of Payments and International Investment Position Manual provides a detailed description of the concepts, definitions, and classifications used. The reference is IMF (2016).

⁶ Net compensation of employees in the balance of payments is low in Portugal, with credits averaging 0.21 percent of GDP and debits averaging 0.18 percent in 1997–2018. As a result, the primary income balance is almost entirely net investment income (which we treat as the primary income balance for expositional purposes).

⁷ The secondary income balance (sometimes referred to as “current transfers”) has two main components: personal remittances and governmental transfers. Current transfers are distinguished from other types of transactions because they are not made in exchange for a corresponding item of economic value.

where N_t is the NIIP (foreign assets minus foreign liabilities), CA_t and KA_t are respectively the current account balance and capital account balance, and VAL_t are valuation changes. Decomposing the current account into its components, this gives:

$$N_{t+1} = N_t + NX_t + (i_{At}A_t - i_{Lt}L_t) + KA_t + VAL_t \quad (2)$$

where NX subsumes the trade and the secondary income balance, and i_A and i_L are yields on respectively foreign assets, A , and foreign liabilities, L , so that $(i_{At}A_t - i_{Lt}L_t)$ is net investment income. Valuation changes are the capital gains earned on the current stocks of foreign assets and liabilities from changes in exchange rates and asset prices. Let kg_A and kg_L denote the rate of capital gains on foreign assets and liabilities respectively. Then:

$$N_{t+1} = N_t + NX_t + KA_t + (r_{At}A_t - r_{Lt}L_t) \quad (3)$$

where $r_{At} = (i_{At} + kg_A)$ and $r_{Lt} = (i_{Lt} + kg_L)$ are the rates of return, inclusive of yields and capital gains, on foreign assets and foreign liabilities.

Equation (3) highlights that even if a country runs trade and capital account surpluses, the NIIP can decline if the rate of return on foreign liabilities sufficiently exceeds that on foreign assets. In fact, even if capital gains were absent, the NIIP could still deteriorate if net investment income flows were large and negative. Furthermore, such a deterioration in the NIIP would lead, all else equal, to even more negative net investment income flows next period, requiring larger trade or capital account surpluses to stabilize the NIIP.

3.1 Composition of the NIIP by financial instrument

The rapid decline of the NIIP in Portugal after 1997 resulted from a domestic demand boom that was largely intermediated by the external borrowings of Portuguese banks (Reis 2013).

Deterioration of the aggregate NIIP was matched by net liability positions in all major classes of the IIP, but most prominently in loans and other debt instruments (Fig. 3). Debt liabilities remain the most significant component of Portugal's external liabilities at the present time. They present a potential impediment to an improvement of the NIIP since, unlike equity liabilities whose value declines with a downturn, debt payments tend to remain largely fixed. Notice that the next largest component of the NIIP is net FDI, which has averaged about -25 percent of GDP since 2008. Given that FDI is in general a source of capital for long-term investment that have positive spillovers on the economy, they represent a beneficial form of liabilities. However, they are much smaller than debt liabilities, averaging about one-third of net debt liabilities since 2008. The large stock of net debt liabilities in turn has had implications for the evolution of the current account due to its impact on the primary income balance.

Source: World Economic Outlook, International Financial Statistics, External Wealth of Nations

Fig. 3 NIIP. Composition by Financial Instrument (percent of GDP)

3.2 Composition of the current account balance

While the traditional model of external adjustment emphasizes the role of net exports in external sustainability, the evolution of the current account in Portugal suggests that other components of the current account are likely to play a larger role. As shown in Fig. 4, trade deficits were the main driver of the current account deficit in the decade following euro accession, while the primary and secondary income balance had small roles.

Since 2012, Portugal has consistently run small trade surpluses, but this has resulted in smaller current account surpluses because servicing the stock of net external liabilities has led to a persistently negative primary income balance. While the primary income balance was small at euro entry (-0.2 percent of GDP in 1997), it steadily weakened and reached a trough of -3.7 percent of GDP in 2009. In 2018, it was -2.8 percent of GDP, much larger in absolute value than the trade surplus of 0.8 percent of GDP. The persistently negative primary income balance has hindered a stronger improvement in the current account.

Given the negative NIIP and large debt liabilities, the primary income balance is likely to remain negative without a material change in the magnitude or composition of the NIIP.⁸ This will continue to be a drag on the current account balance, hindering improvement in the NIIP, and imparting a greater burden of the external adjustment to net exports.⁹

⁸ Even if the yield rates, i_A and i_L , were equal, net investment income would be negative because foreign liabilities exceed foreign assets. The larger are foreign liabilities relative to foreign assets, the larger ($i_A - i_L$) must be for $i_A A$ to exceed $i_L L$ and for net investment income to be positive.

⁹ The capital account in Portugal is mainly investment grants received from the EU (Matos, Menezes and Nunes 2018). It has been positive since 1997 but declined annually since 2012 and stood at 0.9 percent of GDP in 2018.

Fig. 4 Balance of Payment Flows (percent of GDP)

Source: World Economic Outlook

3.3 Rates of return on foreign assets and foreign liabilities

Rates of return on foreign assets and liabilities have been volatile in Portugal (Fig. 5).¹⁰ On average, Portugal has paid a risk premium on its foreign liabilities relative to the return it has earned on foreign assets. The average return differential between foreign assets and liabilities was -1.8 percent over 1997–2018 but improved to -1 percent in the more recent period of 2009–18. The rates of return are driven considerably by capital gains (the implied difference between the rate of return and yields in Fig. 5), while yields have been lower and more stable.

Capital gains can play an important role in the evolution of the external balance. A depreciation of the exchange rate, for example, may not only improve net exports but also raise the local currency value of foreign assets (denominated in foreign currency) more than that of foreign liabilities, resulting in positive revaluation of the NIIP. Given their larger magnitudes relative to yields, changes in capital gains have had a much greater impact on the NIIP relative to the impact of the trade and income balance.

To get a sense of magnitudes, consider the 25.3 billion euros deterioration in the NIIP between 2011 and 2012.¹¹ The yields on foreign assets and liabilities were respectively 2.1 percent and 2.6 percent in 2012, capital gains on foreign assets and foreign liabilities were respectively 3.5 percent and 6.7 percent, and the sum of net exports, current transfers and capital transfers was 3.4 billion euros. Foreign assets and liabilities in 2011 were respectively 328 and 530 billion euros. Using Eq. (3) this implies that the decline of the NIIP in 2012 was driven most significantly by capital losses (of 22.6 billion euros), followed by a net investment income deficit

¹⁰ Capital gains on foreign assets and liabilities are recorded in neither the balance of payments nor national accounts. They are calculated in this paper using the approach of Lane and Milesi-Ferretti (2009).

¹¹ The 2011 nominal GDP of Portugal was 176 billion euros and the NIIP was -202 billion euros, implying that this decline was 14 percent of 2011 GDP and 12.5 percent of the 2011 NIIP.

Fig. 5 Portugal: Rates of Return on Foreign Assets and Foreign Liabilities

(of 6.1 billion euros), which were only modestly offset by trade, current and capital transfers.

Regarding future valuation changes, a structural change at accession has vastly limited the potential for currency-related capital gains. In addition to redenomination of existing foreign assets and liabilities from escudos to euros, subsequent foreign asset acquisitions have been heavily concentrated in euro-denominated instruments and foreign-currency denominated liabilities have fallen significantly. Benetrix et al. (2019) note that as of 2017 the former is 19 percent of foreign assets and the latter 8 percent of foreign liabilities.

If the currency composition of foreign assets and liabilities remains stable, future valuation changes will be derived largely from asset price rather than currency movements. One implication is that, unlike in the United States where about 70 percent of foreign assets and 15 percent of foreign liabilities are denominated in foreign currency (see Gourinchas and Rey 2007), a depreciation of the currency will help improve the NIIP by raising net exports but without much of the favorable bi-product of a positive revaluation of the NIIP.

4 Framework for assessing external sustainability

The traditional framework to assess external sustainability is the inter-temporal budget constraint, which links the NIIP to future paths of the trade balance and net investment income flows. As emphasized in Obstfeld (2012), this approach rests on micro foundations in which a country's current account balance with the rest of the world reflects the forward-looking saving and investment decisions of its residents.

The framework in Blanchard and Das (2017) generalizes the traditional framework to account for capital gains on foreign assets and liabilities.¹² An overview of this framework is given below. Start with Eq. (3) in Sect. 3. Solving forward recursively yields¹³:

$$N_t = -\sum_{j=0}^T \left(\prod_{i=0}^j (1 + r_{Lt+i})^{-1} \right) (NX_{t+j} + (R_{At+j} - r_{Lt+j})A_{t+j-1}) + \left(\prod_{i=0}^j (1 + r_{Lt+i})^{-1} \right) N_{t+T+1} \quad (4)$$

Equation (4) indicates that implementation of the approach will require forecasts of the variables on the right-hand side. In this paper, these are drawn from the IMF World Economic Outlook (WEO) database where forecasts are made holding the REER fixed at its current level.¹⁴ Let e denote the REER and e_0 its current level. Rewriting (4) to emphasize the dependence on e , imposing a no-Ponzi condition, and expressing in ratios to GDP gives:

$$n_t(e) \geq -\sum_{j=0}^T \left(\prod_{i=0}^j \frac{1 + g_{t+i}}{1 + r_{Lt+i}} \right) [nx_{t+j} + (r_{At+j} - r_{Lt+j})a_{t+j-1}]|_{e=e_0} \quad (5)$$

where n_t is the ratio of the NIIP to GDP, nx_t is the ratio of the sum of net exports and current transfers to GDP (henceforth “net exports”), g_t is the growth rate of real GDP and a_t is the ratio of foreign assets to GDP. Equation (5) states that the current NIIP to GDP ratio is sustainable if, at the current level of the REER, it is larger or equal to negative of the PDV of net exports to GDP plus the rate of return differential times the ratio of gross assets to GDP.

The empirical study goes farther than asking if the current NIIP is sustainable. It assesses the feasibility of raising the NIIP to more prudent levels. Suppose it is desired to stabilize the NIIP to GDP ratio at n^* . This implies¹⁵:

$$n_t(e) - n^* \left(\prod_{i=0}^T \frac{1 + g_{t+i}}{1 + r_{Lt+i}} \right) \geq -\sum_{j=0}^T \left(\prod_{i=0}^j \frac{1 + g_{t+i}}{1 + r_{Lt+i}} \right) [nx_{t+j} + (r_{At+j} - r_{Lt+j})a_{t+j-1}]|_{e=e_0} \quad (6)$$

Equation (6) states that if it is desired to stabilize the NIIP at n^* , the current ratio of the NIIP to GDP is sustainable if, at e_0 , its difference from the PDV of n^* is larger than negative of the PDV of the sum of future net exports to GDP and the rate of return differential times the ratio of gross assets to GDP. This is the definition of

¹² Another extension of the intertemporal approach to the current account, which considers the current account response to transitory income shocks, is presented in Kraay and Ventura (2000).

¹³ Note that the formulation in Blanchard and Das (2017) is in terms of “net foreign liabilities” (gross liabilities minus gross assets), which is the negative of the NIIP.

¹⁴ Forecasts in the WEO are also made under the assumption that the only impact of policies on forecasts is from policies already in place or those that have been approved and will be in place during the forecast horizon.

¹⁵ Substituting $N_{t+n+1}=N^*N$ in (4) and expressing in ratios to GDP gives Eq. (6), which corresponds to Eq. (10) in Blanchard and Das.

external sustainability used in Blanchard and Das (2017) and similarly utilized in this paper.

Let e^* denote the REER that satisfies Eq. (6). One approach to assessing sustainability is to quantify the REER adjustment, $(e^* - e_0)$, required to stabilize the ratio of the NIIP to GDP at n^* (e.g. Philipps et al. 2013). Suppose forecasts of net exports, rates of return, and the gross positions at e_0 are such that the right-hand side of (6) is larger than the left-hand side. Then a real effective depreciation from e_0 to e^* (that raises future net exports and imparts a revaluation of the NIIP) will alter both the left- and right-hand sides of (6) to meet the condition for external sustainability.¹⁶¹⁷ This mechanism of adjusting to an external imbalance is analogous to the traditional approach where, however, a role for valuation changes is absent.

A key extension of this framework is a probabilistic assessment of sustainability. The motivation is that the present value terms in Eq. (6) depend on uncertain forecasts and, if realizations are worse than the forecasts, the condition for sustainability may not be met. Blanchard and Das propose stochastic simulations to probabilistically assess sustainability. We refer the reader to their paper for details and present an overview below.

Let $X = (g, r_A, r_L, nx, a)'$ where r_A and r_L are realized rates of return that exclude capital gains from changes in the exchange rate.¹⁸ The strategy is to treat the WEO forecasts of X as the means of the random variables and to use the historical data to construct their joint distribution and, by extension, the joint distribution of their innovations. A first step is to estimate the following vector autoregression (VAR) model of order 1:

$$\begin{bmatrix} X \\ e \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \times \begin{bmatrix} X(-1) \\ e(-1) \end{bmatrix} + \begin{bmatrix} \epsilon_X \\ \epsilon_e \end{bmatrix} \quad (7)$$

The VAR captures the linear inter-dependencies across all the variables, including the REER. However, the IMF forecasts of X in Eq. (6) are made under the assumption of a constant exchange rates. These can be extracted as explained in Blanchard and Das from the sub-matrix $X = A_{11}(L)X(-1) + \epsilon_X$.

Let the forecast horizon be of length T . The next step is to draw a (5×1) vector of innovations, $\hat{\epsilon}_X$, from the VAR and, using the estimated autocorrelation coefficients from the VAR, generate a $(5 \times T)$ path of the innovation vector over the forecast horizon. Finally, this path of innovations is used to generate simulated realizations of $\hat{X}_i = \hat{A}_{11}(L)X_i(-1) + \hat{\epsilon}_{X_i}$ ($i = 1, \dots, M$) where i denotes the draw and M are the number of draws.

¹⁶ A depreciation will raise the value of the NIIP if the foreign currency share of foreign assets to GDP is larger than the foreign currency share of foreign liabilities to GDP. This is the case in Portugal.

¹⁷ Symmetrically, if forecasts at e_0 are such that the expression on the right-hand side of (6) is smaller than the expression on the left-hand side, the condition for external sustainability is met and a real effective depreciation is not required to make the position sustainable. In that case, if the objective is to bring the NIIP to the desired level n^* , this will require a real effective appreciation.

¹⁸ Rates of return are stripped of capital gains from exchange rate changes since the computation of the PDV terms is done holding the exchange rate fixed; the stripping is done as proposed in Benetrix et al. (2019).

For each draw of X , the adjustment of the REER, $(e^* - e_0)$, required to satisfy Eq. (6) is calculated. Iterating this step over M draws yields a frequency distribution of the required REER adjustment. The probability that a REER depreciation is required to satisfy (6) is then numerically calculated from this distribution. The probability that the external position is sustainable is defined as one minus the probability that a REER depreciation is required to satisfy (6).

5 Empirical application

We apply this framework to assess external sustainability in Portugal, which is the focus of this paper. The empirical study begins with a deterministic calculation of the exchange rate adjustment required to meet the condition for external sustainability in Eq. (6), then extends the results to the probabilistic assessment.

5.1 Empirical assessment of external sustainability in Portugal

Our analysis draws on the 5-year forecasts in the October 2019 WEO. Adjustment to a large external imbalance is, however, likely to occur over a period longer than the WEO horizon. One approach to extending forecasts to a longer horizon is to assume that the output gap closes over a longer period.¹⁹ A related approach is to assume that the steady-state is characterized by balanced growth, i.e., the growth rate of exports, imports, real GDP and other components of the balance of payments converge to the WEO forecasted growth rate of potential output (of 1.5 percent for Portugal) over the longer horizon.²⁰ Following the latter approach, we extend the WEO forecasts by 10 years (see Appendix Figures A1 and A2).²¹ Table 1 gives the WEO forecasts for 2019–2024 along with the terminal forecast (depicting the steady-state forecast) in 2034.

The NIIP to GDP ratio is forecast to initially improve between 2019 and 2024. This results from the forecast of trade surpluses and positive capital transfers, which together offset the impact of the forecasted negative rate of return differential ($r_A - r_L$) that range from -0.3 percent to -0.2 percent in this period. As forecasts converge to the steady state as described above, the growth rate of imports exceeds the growth rate of exports (Appendix Fig. A2), and the growth rate of capital transfers declines, so that the sum of the trade and capital account in ratio to GDP converges to a small steady-state deficit of -0.4 percent of GDP. In addition,

¹⁹ This approach is used by the European Central Bank. Details of the approach are in Bouabdallah et al. (2017).

²⁰ This is the approach used at the International Monetary Fund. Details of the approach are in IMF (2018B).

²¹ A period of 15 years is chosen to balance a longer period than just the 5 years of forecast data while bearing in mind that the further out are forecasts, the less certain one can be about them. However, the choice of 15 years (instead of, e.g., 10 years) is simply a subjective choice.

Table 1 IMF World Economic Outlook baseline (2019–25) and steady-state forecasts: Portugal

	2018	2019	2020	2021	2022	2023	2024	2034
NIIP / GDP	-106%	-101%	-98%	-96%	-94%	-92%	-91%	-108%
Assets / GDP	162%	159%	158%	156%	154%	154%	152%	163%
Liabilities / GDP	267%	260%	256%	251%	248%	246%	243%	271%
Trade Balance /GDP		1.4%	0.7%	0.4%	0.3%	0.1%	-0.3%	-0.9%
Capital account /GDP		2.0%	2.2%	1.6%	1.4%	1.1%	1.3%	0.5%
Real GDP growth		1.9%	1.6%	1.5%	1.5%	1.5%	1.5%	1.2%
Real returns on assets		1.9%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%
Real returns on liabilities		2.1%	1.9%	1.8%	1.8%	1.8%	1.8%	2.0%

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the forecasted negative rate of return differential moderately widens to a steady state of -0.5 percent. Consequently, the NIIP to GDP ratio declines to -108% of GDP.

Note that the decline of the NIIP from -106 to -108 percent of GDP does not automatically imply that the NIIP is not sustainable at its current level. As implied by Eq. (6), the assessment of sustainability depends on a comparison of the NIIP less the PDV of the target NIIP with the PDV of the future flow of income from net exports, the rates of return and the asset position. For a high enough forecast of the growth rate relative to the rate of return on liabilities (i.e. a high enough discount factor), the condition in (6) could be met for some n^* , even when the NIIP to GDP ratio is forecast to decline. We turn to that calculation next.

5.2 Deterministic external sustainability analysis

Our approach is to consider an external adjustment that moves the NIIP from -106 percent of GDP in 2018 to several higher (i.e. less negative) levels ranging from -95 percent of GDP to -60 percent of GDP.²²

Taking the forecasts in Table 1 to be held with certainty, a deterministic assessment is as follows. Start with a target NIIP of -95 percent of GDP. Under an adjustment horizon of 15 years, the negative of the PDV on the right-hand side of Eq. (6) is 0.9 percent of GDP. On the left-hand side of (6), the NIIP to GDP less the PDV of the target level is -24 percent of GDP. This implies that the forecasted future net inflow of income is insufficient to stabilize the NIIP at the target of -95 percent of GDP. Thus, a real effective depreciation is required to satisfy Eq. (6).

The semi-elasticity of Portugal's net exports to the REER from the IMF's external balance assessment is -0.23.²³ This implies that a 10 percent depreciation raises

²² At the time of preparing this paper, the 2018 NIIP was the latest published IIP data for Portugal.

²³ IMF (2018A). I assume that the semi-elasticity of net exports to REER is the same in all years of the forecast horizon as in Blanchard and Das so that net exports improve by 2.3 percent of GDP in each forecast year. A richer treatment could allow nonlinear dynamics of the trade balance, such as J-curve effects.

Table 2 Required adjustment of the REER to stabilize the NIIP in Portugal Deterministic Calculations

(a) Target NIIP	(b) PDV of Target NIIP	(c) Current NIIP minus PDV of Target NIIP	(d) PDV of net exports and net income flows	(e) Required REER adjustment	(f) Required REER adjustment, trade channel only
-95%	-82%	-24%	-0.9%	-7.1%	-6%
-90%	-77%	-28%	-0.9%	-8.3%	-7.2%
-80%	-69%	-37%	-0.9%	-10.7%	-9.6%
-75%	-64%	-41%	-0.9%	-11.9%	-10.8%
-70%	-60%	-45%	-0.9%	-13.2%	-12.0%
-60%	-51%	-54%	-0.9%	-15.6%	-14.5%

net exports by 2.3 percent of GDP. The semi-elasticity of the NIIP to the exchange rate, using the shares of foreign assets and liabilities denominated in foreign currency from Benetrix et al. (2019), indicates that a 10 percent depreciation improves the NIIP by 0.7 percent of GDP.²⁴ Putting the two together, a real effective depreciation of 7.1 percent is needed to stabilize the NIIP at -95 percent of GDP.

I repeat this calculation for other target NIIPs and present the results in Table 2.²⁵ As the target increases, the difference between the current NIIP and the PDV of the target NIIP declines (i.e. becomes a larger negative), requiring larger depreciation to generate the trade surpluses to satisfy Eq. (6). Stabilizing the NIIP at -80 percent of GDP requires a REER depreciation of 10.7 percent; stabilizing at -70 percent of GDP a 13.2 percent depreciation; and stabilizing at an NIIP of -60 percent of GDP a nearly 16 percent depreciation.

Consider the role of the financial channel in these calculations. According to Table 1, the forecasted rate of return differential is negative, declining from -0.2 percent in 2019 to -0.5 percent in 2034. Forecasted foreign assets rise from 159 to 163 percent of GDP in this period. This implies a net outflow of income due to the financial channel from 0.3 percent of GDP in 2019 to 0.7 percent of GDP in 2034. If, as in the traditional approach, we ignored the financial channel of adjustment, the PDV in column (d) would be less negative. All else equal, this would imply a smaller required depreciation to satisfy Eq. (6). This is confirmed in column (f) which

²⁴ The calculation is as follows: foreign assets and foreign liabilities are respectively 161 and 287 percent of GDP in 2018. The foreign currency shares of foreign assets and foreign liabilities are respectively 19 and 8 percent. This implies that foreign-currency denominated assets are 30 percent of GDP ($.19 \times 161$), and foreign-currency denominated liabilities are 23 percent of GDP ($.08 \times 287$). Therefore, a 10 percent depreciation of the currency raises the value of foreign assets by 3 percent of GDP, that of foreign liabilities by 2.3 percent of GDP, thus improving the NIIP by 0.7 percent of GDP.

²⁵ It would be useful to consider a richer exercise in which the VAR is estimated on the subsample of the years of the monetary union (2002–18) since accession to the euro may have affected the relation between the shocks. Unfortunately, the available time series is too small to estimate shorter VARs. For example, the 2002–18 subsample contains 15 annual observations for a VAR on 6 variables. Once the 2 outlier years are excluded (see footnote to Table 3), this leaves a sample size of 13 observations that is unsuitable for a VAR with 6 variables.

Table 3 Correlation matrices of the VAR innovations: Portugal (1982–2018)

CPI-REER						
	nx	g	r_L	r_A	a	e
nx	0.014					
g	-0.72	0.016				
r_L	-0.12	0.13	0.086			
r_A	-0.16	0.13	0.89	0.063		
a	-0.37	0.19	0.01	0.23	0.09	
e	0.19	-0.2	-0.24	-0.34	-0.42	0.02
ULC-REER						
	nx	g	r_L	r_A	a	e
nx	0.015					
g	-0.61	0.014				
r_L	-0.03	0.26	0.073			
r_A	-0.13	0.39	0.92	0.062		
a	-0.58	0.58	0.04	0.12	0.08	
e	-0.53	0.28	0.09	0.18	0.48	0.03

Diagonal elements are standard deviations. The estimated VARs are of order 1 using annual data on Portugal from 1982–2018 but excluding 1998, 2008 and 2012 due to the presence of large outliers. The autocorrelation coefficients for (nx, g, r_L , r_A , a, e) in panel (a) are (0.72, 0.64, 0.62, -0.78, 0.67, 0.84) and in panel (b) they are (0.71, 0.41, 0.84, -0.82, 0.17, 0.39)

calculates the REER adjustment by switching off the financial channel of adjustment (setting $r_A = r_L$).

The deterministic results indicate the magnitude of REER adjustment required to satisfy external sustainability, but not the likelihood that an adjustment is required. This calculation is done next.

5.3 Probabilistic external sustainability analysis

Following the approach outlined in Sect. 4, a VAR of order 1 is estimated using historical data on (X , e) from 1982–2018 (1982 is the earliest year for which data on all variables are available). Two VARs are estimated: one using the REER deflated by the CPI (“CPI-REER”) and the other using the REER deflated by ULCs (“ULC-REER”).

It would be useful to consider a richer exercise in which the VAR is estimated on the subsample of the years of the monetary union (2002–18) since accession to the euro may have affected the relation between the shocks. Unfortunately, the available time series is too small to estimate shorter VARs. For example, the 2002–18 subsample contains 15 annual observations for a VAR on 6 variables. Once the 2 outlier years are excluded (see footnote to Table 3), this leaves a sample size of 13 observations that is unsuitable for a VAR with 6 variables.

The estimated correlation matrix of (ϵ_X, ϵ_e) is given in Table 3. The correlations of innovations are largely of the same sign and similar magnitudes using either the CPI-REER in panel (a) or ULC-REER in panel (b). One difference is that shocks to net exports are positively correlated with CPI-REER shocks but negatively correlated with ULC-REER shocks. To the extent that prices are more flexible in the tradable sector, one rationalization for this finding is that a labor productivity shock in the tradable sector that lowers ULCs may trigger expenditure switching via a price adjustment in the tradable sector; as non-tradable sector prices are less flexible, however, there is likely to be a delayed adjustment in the CPI-based REER with a correspondingly low observed correlation with shock to net exports.

Using the submatrix $X = A_{11}(L)X(-1) + \epsilon_X$ of the estimated VAR, for each target of the NIIP, I draw 10,000 realizations of X and, for each draw, I calculate the REER adjustment required to satisfy Eq. (6). The resulting frequency distribution of the REER adjustments (one for each target level of the NIIP) is shown in Fig. 6. Moments of the frequency distribution are in Table 4. The main findings are as follows.

Starting with a target NIIP of -95 percent of GDP, the mean REER depreciation required to stabilize the NIIP is about 8 percent, with a standard deviation of 55 percent.²⁶ Under a normality assumption on the frequency distribution, this implies that the probability the REER must depreciate to stabilize the NIIP is about 57 percent, and thus the probability that the external position is sustainable is 43 percent. As the target moves farther away from the current NIIP, the probability that the REER must depreciate to stabilize the NIIP at the target level becomes larger and thus, the probability that the external position is sustainable declines. For a target of -60 percent of GDP, the probability the REER must depreciate is 68 percent and the probability the external position is sustainable is 32 percent. Overall the results indicate that the probability the current external position is sustainable lies between 32 percent for a large adjustment and 43 percent for a small adjustment.

An assessment that the external position is sustainable with a probability as high as 43 percent may appear contradictory with the more typical commentary that a large external adjustment in Portugal is inevitable (e.g. Alcidi et al. 2016). These statements are mutually compatible. The mean required REER depreciation—ranging from 8 to 16 percent—is the likely scenario for Portugal. The probabilistic view reflects that, given the historical evidence, both positive and negative shocks can affect the likelihood of an adjustment.²⁷

To elaborate on this point, note that the historical dispersion of financial account shocks in Portugal are much larger than the dispersion of trade shocks (see Table 3). Its implications for external adjustment can be significant. Based on panel (a) in Table 3: for foreign assets of 162 percent of GDP, a simultaneous

²⁶ The mean REER adjustment is not identical to the deterministic case (Table 2) because the PDV in Eq. (6) is not linear in the random variables.

²⁷ The results using ULC-REER are similar. They are shown in Fig. 6. For brevity, they are omitted in Table 4.

Source: IFS, WEO and author's calculations

Fig. 6 Portugal: Frequency Distribution of the REER adjustment required to stabilize the NIIP/GDP at Alternative Targets

one-standard deviation shock to the rate of return on foreign assets (8.6 percent) and foreign liabilities (6.3 percent) can move the NIIP by 3.7 percent of GDP, overwhelming the impact from a one standard deviation shock to net exports which moves the NIIP by 1.4 percent. The probabilistic assessment reflects that in some states of the world, large positive shocks to the financial account can occur and speed the stabilization of the NIIP to GDP ratio.

Table 4 REER Adjustment to Stabilize the NIIP in Portugal: Moments of the Frequency Distributions Probabilistic Calculations

Unrestricted model: Trade and Financial Adjustment				Restricted Model: Only Trade Adjustment		
(a) Target NIIP	(b) Mean	(c) Std. Deviation	(d) Probability REER adjustment < 0	(e) Mean	(f) Std. Deviation	(g) Probability REER adjustment < 0
-95%	-7.6%	55%	57%	-5.2%	16%	62%
-90%	-8.1%	49%	58%	-6.9%	16%	67%
-80%	-11.2%	47%	61%	-10.1%	15%	76%
-75%	-13.2%	44%	63%	-11.4%	15%	78%
-70%	-13.9%	39%	66%	-11.9%	13%	82%
-60%	-16.2%	38%	68%	-13.1%	11%	88%

This table reports the probability that the REER must depreciate to raise the NIIP from its 2018 level of -106 percent of GDP to several target NIIPs. For each target NIIP, 10,000 Monte Carlo simulations of Eq. (6) using the joint distribution of innovations in Table 3 are used to construct a frequency distribution of the required REER adjustment. The probability that the external position is sustainable is calculated as 1 minus the probability that the REER adjustment is below zero

To further consider this point, I recalculate the results, this time restricting adjustment to occur just through the trade channel. The results are reported in Table 4, Panel (2). As shocks to net exports have low dispersion, the range of the distribution of the PDV of net exports in the restricted model will be smaller than the corresponding PDV in the unrestricted model (with both trade and financial channels of adjustment). In turn, this will limit the range of the distribution of required REER adjustments.

The results support this assertion. In the restricted case, the distributions of REER adjustments are centered at less negative depreciations and with lower dispersion. As a result, for each target NIIP, the probability that a depreciation is required to stabilize the NIIP is higher and the probability of external sustainability is lower. For example, for a target NIIP of -60 percent of GDP, in the unrestricted case we would conclude that the probability of sustainability is 32 percent. In the restricted model, this probability is just 12 percent.

5.4 Comparative analysis: application to Ireland

To provide context to the results for Portugal, I apply the sustainability framework to Ireland. The quantitative results for Ireland add perspective to the assessment for Portugal by comparison with another eurozone country that has a highly negative NIIP. I begin with a brief overview of Ireland's external position.

Ireland's NIIP to GDP ratio in 2018 was -159 percent of GDP, which placed it as the most negative in the European Union. Equally significant were the gross positions underlying the NIIP, which are vastly higher than in Portugal: foreign assets and foreign liabilities in 2018 were respectively 1440 percent of GDP and 1599 percent of GDP. Net investment income has been correspondingly large, averaging

Table 5 IMF World Economic Outlook baseline (2019–25) and steady-state forecasts: Ireland

	2018	2019	2020	2021	2022	2023	2024	2034
NIIP / GDP	-159%	-149%	-139%	-129%	-120%	-113%	-107%	-89%
Assets / GDP	1440%	1416%	1389%	1356%	1327%	1307%	1288%	1166%
Liabilities / GDP	1599%	1565%	1528%	1486%	1448%	1420%	1395%	1254%
Trade balance /GDP		33%	32%	32%	31%	31%	30%	19%
Capital account /GDP		-5.2%	-4.9%	-4.7%	-4.7%	-4.7%	-4.7%	-4.1%
Nominal GDP growth		0.6%	4.3%	5.4%	5.4%	5.2%	5.4%	2.6%
Real GDP growth		4.2%	3.4%	3.1%	2.8%	2.7%	2.6%	2.6%
Real returns on assets		1.8%	1.9%	1.9%	2.0%	2.0%	2.1%	2.2%
Real returns on liabilities		3.0%	3.2%	3.4%	3.5%	3.6%	3.7%	3.5%

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-15.8 percent of GDP between 1997 and 2018. The current account has nevertheless averaged only a small deficit of -0.7 percent of GDP in this period owing to persistent trade surpluses that have averaged 16 percent of GDP in 1997–2018, including a trade surplus of 33 percent of GDP in 2018.

Rates of return on Ireland's external balance sheet have exhibited significant volatility, with an average differential between the rate of return on foreign assets and foreign liabilities of -1.8 percent over the last 20 years. Benetrix et al. (2019) report that as of 2017 the shares of foreign assets and foreign liabilities denominated in foreign currency are respectively 70 and 20 percent. These shares, in conjunction with the large gross asset and liability positions, indicate high exposure to valuation changes via exchange rates.

The analysis begins with the WEO forecasts for 2019–2024 and the terminal forecasts through 2034 for Ireland, shown in Table 5. The forecast is for large trade surpluses from 2019 to 2024. As forecasts converge to the WEO forecasted growth rate of potential output (of 2.6 percent for Ireland), the growth rate of imports exceeds that of exports, and the trade balance converges to a steady-state surplus of 24 percent of GDP. Negative return differentials are forecast throughout this time period. Given the large gross foreign asset position, they imply equally large net investment income flows from about -17 percent of GDP in 2019 to a steady state of -15 percent of GDP in 2034. Capital transfers are also projected to remain large at about -4 percent of GDP in steady state. The combined impact of capital transfers and the negative return differentials on the NIIP is, however, more than offset by the forecasted trade surpluses. As a result, the forecast of the NIIP to GDP ratio improves from -159 percent of GDP in 2019 to -89 percent of GDP in 2034.

Before turning to the results, I highlight three differences between the external sector characteristics of Ireland and Portugal that can affect the assessment of sustainability: the forecast of net exports, the magnitude of gross positions, and the foreign-currency shares of foreign assets and foreign liabilities.

First, suppose the Ireland forecasts in Table 5 held with certainty. An immediate difference from Portugal is the forecast of large trade surpluses which suggests that,

Table 6 Ireland: Required adjustment of the REER to stabilize the NIIP at target levels Deterministic calculations

(a) Target NIIP	(b) PDV of Target NIIP	(c) Current NIIP minus PDV of Target NIIP	(d) PDV of net exports and net income flows	(e) Required REER adjustment	(f) Required REER adjustment, trade channel only
-150%	-129%	-30%	113%	5.7%	25.1%
-140%	-120%	-39%	113%	5.1%	24.5%
-130%	-112%	-47%	113%	4.5%	23.8%
-120%	-103%	-56%	113%	3.9%	23.3%
-115%	-99%	-60%	113%	3.6%	23.0%
-110%	-95%	-64%	113%	3.3%	22.7%

Current NIIP is the 2018 NIIP of -159% of GDP. The adjustment horizon is 15 years. Column (c) is the left-hand side of Eq. (6), column (d) the negative of the right-hand side of Eq. (6). Column (e) corresponds to the PDV in column (d). The semi-elasticity of net exports and the NIIP to the REER are respectively -0.52 and 6.9

unless discount factors are very low or the desired level n^* much larger than the current NIIP, the PDV of the future net inflows of income is likely to be large enough to meet the condition for sustainability in Eq. (6).

Second, following the same calculations as before, the large gross positions and the high foreign-currency share of foreign assets in Ireland imply that the semi-elasticity of the NIIP with respect to exchange rates is 6.9. While a 10 percent depreciation results in moving the NIIP by 0.7 percent of GDP in Portugal, the corresponding number for Ireland is orders of magnitude higher at 69 percent of GDP.²⁸ This implies that even if the NIIP in Ireland is assessed unsustainable at the current exchange rate, a very small depreciation could suffice to restore sustainability by imparting a large revaluation of the NIIP. Third, the semi-elasticity of Ireland's net exports to the REER reported in Kang and Shambaugh (2014) is -0.52, which is more than double that in Portugal. Thus, all else equal, a depreciation will raise net exports more (and more easily stabilize the NIIP) in Ireland.

I begin with the deterministic assessment. The results are reported in Table 6. As before, for each target level of the NIIP, the NIIP less the PDV of the target (column (c)) is compared with the PDV of net exports and net income flows (column (d)). The results show that the condition for external sustainability is met for all targets. As the negative of the PDV in column (d) is smaller than required to stabilize the NIIP at each target level, a real effective *appreciation* (that lowers net exports and imparts a negative revaluation of the NIIP) is required to stabilize the NIIP at the target level.

²⁸ The shares of foreign assets and liabilities in foreign currency are respectively 0.7 and 0.2. Thus foreign-currency denominated assets are 1007 percent of GDP, foreign-currency denominated liabilities 319 percent of GDP and a 10 percent depreciation of the currency raises the value of the NIIP by 68.8 percent of GDP.

Table 7 Correlation matrices of VAR innovations: Ireland (1982–2018)

	nx	g	r_L	r_A	a	e
nx	<i>0.029</i>					
g	-0.80	<i>0.028</i>				
r_L	-0.49	0.15	<i>0.031</i>			
r_A	0.17	0.21	0.81	<i>0.039</i>		
a	-0.00	0.00	-0.06	0.06	<i>0.01</i>	
e	-0.63	-0.25	-0.10	-0.16	-0.15	<i>0.15</i>

Diagonal elements are standard deviations. The VARs are of order 1 and estimated on data from 1982 through 2018 excluding 2015. The REER is the CPI-based REER. The autocorrelation coefficients for (nx , g , r_L , r_A , a , e) are (0.72, 0.64, 0.62, -0.78, 0.67, 0.84) and in panel (b) they are (0.71, 0.41, 0.84, -0.82, 0.17, 0.39)

Despite the large difference between the terms corresponding to the left- and right-hand side of Eq. (6) (respectively columns (c) and (d)), note that the magnitudes of the required REER adjustments in column (e) are modest. This results from the large semi-elasticities of net exports and the NIIP to the exchange rate.

According to Table 5, the forecasted rate of return differential is negative which implies that net income outflows from the financial channel partially offset the large trade surpluses. Thus, the PDV of future flows of income reported in column (d) would be even larger in the absence of the net income flows and, ignoring the financial channel of adjustment would lead to even larger required REER adjustments than those reported in column (e) to stabilize the NIIP at the target levels. This is what I find in column (f), where I report the REER adjustment when the adjustment is restricted to the trade channel.

Even though the deterministic findings suggest that the NIIP in Ireland is sustainable at the current exchange rate, this does not imply that the probability of a downward adjustment of the exchange rate to meet the condition in Eq. (6) is equal to zero. As in Portugal, both positive and negative shocks to the forecasts can affect the probability of an adjustment.

Following the approach in the previous section, I now turn to a probabilistic assessment of external sustainability in Ireland. Table 7 presents the correlation matrix of the innovations. Note that innovations of r_A and r_L are smaller than those in Portugal. This likely reflects that shocks to rates of return act on much larger stocks of assets and liabilities in Ireland than in Portugal.

Going through the same steps as before, the results of the probabilistic calculations are given in Table 8. Panel (1) gives results for the unrestricted model and panel (2) for the restricted model. Starting with a target level of -150 percent of GDP, the mean REER adjustment required to stabilize the NIIP is an appreciation of 8 percent with a standard deviation of 31 percent. Under a normality assumption for the frequency distribution of the required REER adjustment, this implies that the probability that the REER must depreciate to stabilize the NIIP is about 40 percent, and thus the probability that the external position is sustainable is about 60 percent.

As the target NIIP becomes more ambitious, the probability that the forecasted trade surpluses can stabilize the NIIP at the desired target level declines and thus,

Table 8 REER Adjustment to Stabilize the NIIP in Ireland: Moments of the Frequency Distributions Probabilistic Calculations

Unrestricted model: Trade and Financial Adjustment				Restricted Model: Only Trade Adjustment		
(a) Target NIIP	(b) Mean	(c) Std. Deviation	(d) Probability REER adjustment < 0	(e) Mean	(f) Std. Deviation	(g) Probability REER adjustment < 0
-150%	8%	31%	40%	27%	18%	6%
-140%	7%	30%	40%	27%	19%	7%
-130%	6%	30%	42%	25%	19%	9%
-120%	6%	30%	42%	24%	20%	11%
-115%	4%	28%	44%	24%	21%	12%
-110%	2%	28%	46%	23%	21%	13%

This table reports the probability that the REER must depreciate to raise the NIIP from its 2018 level of -159 percent of GDP to several target NIIPs. For each target NIIP, 10,000 Monte Carlo simulations of Eq. (6), using the joint distribution of innovations in Table 7, are used to construct a frequency distribution of the required REER adjustment. The probability that the external position is sustainable is calculated as 1 minus the probability that the REER adjustment is below zero

the probability that a depreciation is required for external sustainability rises. For a target NIIP of -130 percent of GDP, the probability that the REER must depreciate to stabilize the NIIP is 42 percent, while for a target of -110 percent of GDP, this probability rises to 46 percent. In the restricted model, where the large trade surpluses are not offset by net investment income outflows, the probability that a depreciation is required to stabilize the NIIP are correspondingly lower, ranging from 6 percent for a target of -150 percent of GDP to 13 percent for a target of -110 percent of GDP.

Overall, the probability that a REER depreciation is required to stabilize the NIIP at a level that is about 10 to 50 percentage points higher than its current level, ranges from 40 to 46 percent. Although these probabilities are lower than for raising the NIIP by comparable magnitudes in Portugal, the important takeaway is that they are significantly larger than zero. That is, probabilistically, a downward adjustment of the real effective exchange rate to support an external adjustment cannot be ruled out in Ireland either.

6 Conclusion

The purpose of this paper is to assess external sustainability in Portugal, one of the highest net debtors in the eurozone. Despite significant interest in the scope for external adjustment in a currency union, previous work has not quantified the magnitude or probability of the relative price adjustment required to facilitate this adjustment. Using a new framework from Blanchard and Das (2017), I provide both a deterministic and probabilistic assessment of external sustainability in Portugal.

To provide context for these results, I also apply the framework to Ireland, currently the most externally indebted country in the European Union.

This work contributes to the research on external adjustment in two ways. First, in a departure from the traditional approach, the results take account of the financial channel of adjustment. In the deterministic case, I illustrate that failing to do so could understate the depreciation required to make the external position sustainable in Portugal. In Ireland, where the IMF forecasts are of net trade and financial flows larger than required to stabilize the NIIP, ignoring the financial channel would overstate the real appreciation required to bring the NIIP to the target level.

Second, because forecasts are uncertain, a deterministic finding that a depreciation is required to restore external sustainability may still imply a high probability that the NIIP is sustainable at the current exchange rate. This is the case in Portugal, where the probability that the external position is unsustainable is only 68 percent for an ambitious target NIIP of -60 percent of GDP. Symmetrically, a deterministic finding that a depreciation is *not* required to restore external sustainability may nevertheless imply a high probability that the NIIP is unsustainable at the current exchange rate. This is the case in Ireland, where the probability that the external position is unsustainable is 40 percent, even when the target NIIP to GDP is within 10 percentage points of the current NIIP to GDP ratio.

The probabilistic results in this paper emphasize that in some states of the world, shocks to forecasts can be large and favorable, thus speeding the stabilization of the NIIP to GDP ratio, or large and adverse, raising the probability of requiring an external adjustment.

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