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# Scotland's Currency Options

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This report is accompanied by an animation available on YouTube which we hope introduces the main issues in this report to as wide as possible audience <http://www.youtube.com/watch?v=mBC0mLFz91o>. This report is a slightly edited version of the report posted on the NIESR website on 26 September, 2013. Both the animation and the research were funded by the Economic and Social Research Council.

## 1. INTRODUCTION

*"Monetary arrangements are given birth at conference tables, and laid to rest in foreign exchange markets."* M Dooley, (1998).<sup>3</sup>

The choice of currency arrangement is fundamental to the economics of independence. It matters much more than simply the notes and coins in our pockets. It determines how monetary policy is managed, whether there is a separate exchange rate policy, exposure to financial sector risks and even the scope for fiscal policy. In many ways, the choice of currency arrangement will determine the economic governance of an independent Scotland.

This report considers the main currency options that would be open to an independent Scotland. Our major assumption throughout the report is that an independent Scotland would make the institutional changes consistent with EU membership. The currency options we consider are a sterling currency union, (re)-introducing an independent Scottish currency (which we call the Scots pound) and the euro zone. Within each currency option there are many alternative arrangements. Credible arrangements within a sterling currency union and the euro zone would require the agreement of the UK government and European Union respectively.

In our view, no currency option is best when considered against all criteria. Therefore, a rational assessment comes down to comparing the welfare consequences of each criterion. We take a different approach to the Treasury and Fiscal Commission Working Group (FCWG), who primarily focus on trade in an Optimal Currency Area framework.<sup>4</sup> Recent events around the world, particularly in Europe, have shown that fiscal sustainability and currency arrangements cannot be considered in isolation. The evidence suggests that the welfare cost of a disruption in currency arrangements and the economic consequences are an order of magnitude greater than other costs.

Assessing currency options is complicated because an independent Scotland would, in economic terms, be a very different country to today. First, Scotland would be an exporter of hydrocarbons while the UK would be an importer. A one-size-fits-all monetary policy may no longer be as appropriate. Second, the Scottish Government would almost immediately have to issue a large amount of bonds to repay its share of existing UK public debt. The division of debt and practicalities of

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<sup>3</sup> M Dooley, (1998).

<sup>4</sup> HM Treasury is publishing a series of papers on Scottish independence and the Fiscal Commission Working Group is a sub-group of the Scottish Government's Council of Economic Advisers advising on a macroeconomic framework for an independent Scotland.

repayment are important for public finances on both sides of the border. Third, the Bank of England would continue as an UK institution, but without legal responsibility to Scotland.

Each change would have consequences for Scotland's fiscal position. For an independent Scotland to prosper, it requires a 'hard' currency, one in which investors are willing to hold long-dated assets at a reasonable price. A necessary condition for a 'hard' currency is that government solvency must be beyond doubt. If this condition is met, then a long-term domestic debt market can develop which supports public finances and financial stability. If it is in doubt, then investors and citizens may choose to hold assets in another currency or simply no longer subscribe to government debt issues.

Based on OBR projections of UK debt in 2016 and any reasonable division, Scotland would begin its independence with a substantial amount of debt. To illustrate the possible consequences we perform two quantitative exercises. First, we estimate the borrowing costs for an independent Scotland within a sterling currency zone, taking into account different scenarios of initial public debt and deficit levels. Second, we use these borrowing costs to assess the primary surpluses – the difference between total revenues and total expenditures, excluding interest on debt – which Scotland must run to achieve specific debt to GDP ratios 10 years after independence.

- We estimate that an independent Scotland within a sterling currency zone would face long-run average borrowing costs of between 72 and 165 basis points over UK borrowing costs. There is greater statistical precision over the upper bound estimate. Added to the UK average ten year bond yield between 2000 and 2012 suggests borrowing costs would have been between 4.82% and 5.75%.
- Using the lower bound borrowing cost estimate of 4.82%, Scotland would need to run primary surpluses of 3.1% annually order to achieve a Maastricht defined debt to GDP ratio of 60% after 10 years of independence.<sup>5</sup> Given Scotland's estimated average primary fiscal deficit of 2.3% (including taxes from oil and gas) over the period 2000-2012, running a surplus of 3.1% would represent a fiscal tightening of 5.4%. These estimates assume that Scotland would receive a geographic share of hydrocarbon reserves and real GDP would grow at 2% annually.

The results of our baseline scenario, where Scotland takes on a per capita share of UK government debt and a geographic share of oil, indicates that a very tight fiscal adjustment would be necessary for Scotland to achieve a 60% debt to GDP target in 10 years<sup>6</sup>. The greater the share of debt and the smaller the share of assets (primarily oil and gas) which Scotland receives at independence,

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<sup>5</sup> Note that the Maastricht public debt figure for UK public debt is significantly higher than the UK public sector net debt figure.

<sup>6</sup> The Maastricht definition of sustainable public finances is government debt not more than 60% of GDP.

the greater the fiscal adjustment that would be necessary. In turn, the greater the fiscal adjustment, the more vulnerable Scotland would become to adverse shocks (such as a sharp fall in the oil price or a recession), as its scope for adjustment would be smaller.

The greater the amount of public debt an independent Scotland assumes, the greater the importance of retaining some policy flexibility and the stronger the case for introducing a new Scottish currency. There is a close link between the stability of public finances and the banking system, in part because domestic banks hold a high proportion of government debt among their liquid assets. Countries with their own currency have an extra degree of policy freedom which allows them to pursue exceptional monetary policy measures to support the financial system if necessary.

This is not to downplay the risks of introducing a new currency. Whether borrowing costs would be higher or lower than in a currency union depends on the credibility of the Scottish government to reduce its debt burden. Scotland would need a stabilization plan with the same degree of fiscal adjustment. To emulate the other advanced smaller European countries which successfully use their own currencies (Sweden, Norway, Denmark and Iceland), Scotland would need to reduce its debt burden substantially. One option is an assets-for-debt swap (oil and gas reserves for public debt) which would significantly improve its initial debt position. Given that an independent Scotland is also likely to pay a higher rate on servicing its debt than it would receive on its investments, this has economic merit.

## 2. CURRENCY OPTIONS

This report looks at the currency options available to an independent Scotland. If the referendum vote is in favour of independence, a transition process starts which would lead to an independent Scotland within two years. Scotland's new constitution and laws would create a new economic governance structure. The remaining UK nations would constitute the continuing UK and its institutions would no longer include Scotland as part of its governing jurisdiction.<sup>7</sup> In particular, the Bank of England would continue to be an institution of the UK government but without legal responsibility to Scotland, unless agreed otherwise between governments.

We assume that Scotland would join the European Union at the earliest opportunity.<sup>8</sup> The process would be unprecedented and therefore uncertain, but it would inevitably require substantial change to existing monetary arrangements. First, Scotland would require its own independent central bank (which we call the Central Bank of Scotland or CBoS). Second, Scotland would require a national financial regulator and supervisor. Third, we assume membership would require a commitment to join the euro, and that timing would be unspecified, but depend on meeting the Maastricht criteria (see Box 2.2 below).<sup>9</sup> Irrespective of its currency choice, an independent Scotland would also require a debt management office, capital markets for bonds and equities as well as a revenue and customs office and a fully functioning exchequer or finance ministry.<sup>10</sup>

### A. Currency policy options

We now consider the realistic currency policy options for an independent Scotland. The currency policy question really has two parts: first, which currency to use and, second, the specific policy arrangement given that choice of currency. For example, Scotland could re-introduce its own currency, and the policy arrangement could either be a floating or fixed exchange rate. In some ways, the second decision is as important as the first. While an independent Scotland could, in theory, use any currency in the world it wishes, specific policy arrangements are likely to require the agreement of other governments.<sup>11</sup> Three realistic currency options are summarised in Table 2.1 and in each option the two extreme arrangements are presented. Clearly there is a whole gradient between these extremes.

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<sup>7</sup> See S Tierney (2013) for a comprehensive discussion.

<sup>8</sup> See S Tierney (2013) for further discussion.

<sup>9</sup> This would be consistent with the treatment of new accession countries, although given the exceptional circumstances Scotland may be awarded with possible derogations allowing postponement.

<sup>10</sup> Capital markets are necessary because the flow of saving each month (e.g. pension investments) would leave Scotland to be invested in effectively an 'overseas' markets.

<sup>11</sup> Only the options for an independent Scotland are presented as there is no question of Scotland continuing to use sterling if voters choose to remain in the Union.

**Table 2.1: Summary of an independent Scotland's feasible currency options**

| Currency                | Arrangement             | Transaction costs | Monetary policy          | Financial stability | Fiscal policy    |
|-------------------------|-------------------------|-------------------|--------------------------|---------------------|------------------|
| Scots pound             | Fixed                   | Highest costs     | Central Bank of Scotland | Scotland            | No formal limits |
|                         | Floating                |                   | Central Bank of Scotland | Scotland            | No formal limits |
| Sterling currency union | Formal currency union   | None              | Bank of England          | Shared with UK      | Formal limits    |
|                         | Informal currency union |                   | Bank of England          | Scotland            | No formal limits |
| Euro                    | Formal currency union   | Medium Costs      | European Central Bank    | Shared with EU      | Formal limits    |
|                         | Informal currency union |                   | European Central Bank    | Scotland            | No formal limits |

Table 2.1 presents four criteria by which to consider each of the currency options. A sterling currency union offers the lowest transition and transaction costs and perhaps the greatest possibility of financial stability. However, this option would offer the least monetary, exchange rate and possibly fiscal flexibility. The Scots pound option has the highest transaction costs and least assistance with financial support but also the greatest degree of flexibility in monetary, exchange rate and fiscal policy terms. Finally, it is difficult to know what to make of the euro while so much is being reconsidered. According to the UK government, its limits on fiscal policy would be tougher than in the euro area. There are attractions to being an equal partner in a central bank with shared financial sector risks without overly intrusive fiscal measures.

Regardless of the currency option chosen, EU membership would require the establishment of an independent central bank. The choice of currency arrangement is central to the remit of the CBoS and the functions it can be expected to perform. Central banks have traditionally had two fundamental objectives. The first objective is to stabilise prices and support general economic activity through a variety of instruments such as short-term interest rates and foreign exchange market operations. Second, the much older objective is to maintain a stable and efficient financial system through liquidity operations, participating in the payments system and in, exceptional circumstances, facilitating emergency support for troubled banks. The scope and toolkit for the CBoS to achieve these objectives depends on the government's choice of currency management.

**i. Scots pound option**

Many advanced and smaller sovereign countries use their own currency. In Europe, Denmark, Sweden and Norway are examples in Europe of countries of similar size and income levels which

successfully use their own currency. If Scotland introduces its own currency, this makes the transition to eventually joining the euro more straightforward as this fulfils one of the accession criteria. Having a Scottish currency brings the greatest degree of autonomy over economic policy and so is perhaps the most consistent with the notion of economic independence. However, this is a double-edged sword: a newly independent country with no track record and substantial debt will need to earn the credibility that the greater autonomy and flexibility will be used appropriately.

The transition to a new currency raises significant transitional challenges. Additional new institutions would be required including a payments system, local currency capital markets and a macro-prudential financial regulator. Goodhart (2012) suggests that the special sterling notes held at the Bank of England backing the current issuance of Scottish notes could be transferred to the CBoS and then exchanged for domestic and foreign assets to capitalise the CBoS.<sup>12</sup> Based on this year's accounts, around \$9bn would also be transferred to the CBoS as Scotland's per capita share of foreign reserves.<sup>13</sup> This is clearly too little and a policy priority would be to accumulate reserves through running balance of payments surpluses.

Another way to accumulate reserves would be to generate seigniorage. If Scotland chose to issue its own currency (which we call the Scots pound) then it could, in theory, create an almost unlimited supply at virtually no cost. The seigniorage revenue would be the difference between the value of currency and its cost of production, and would be transferred to Scotland's new Treasury.<sup>14</sup> The amount of seigniorage the CBoS could earn would depend on the size of its balance sheet. If this is a comparable proportion to the Bank of England prior to the crisis, seigniorage would be around 0.2% of GDP.<sup>15</sup> To assure citizens that it will not abuse the ability to issue currency and possibly cause inflation, governments generally grant their central banks independence to deliver the government's targets. For example, in 1997 the UK Treasury granted the Bank of England operational independence to set monetary policy to deliver an inflation target. The CBoS would be required to be independent by EU Treaty, but the Scottish government has ultimate responsibility by setting the policy targets.

Central banks which issue their own currency can play a special role in supporting financial stability. They have a unique feature in that unlike private firms, they need not default. If the CBoS

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<sup>12</sup> Scottish notes issued by Scottish commercial banks are backed by assets held at the Bank of England (or other permitted locations). These notes include the 'giants' and 'titans' of £1mn and £10mn denominations.

<sup>13</sup> According to the Exchange Equalisation Accounts (EEA) to March 2013, UK foreign exchange reserves consist of £62.4bn in the EEA and £5.6bn in the National Loans Fund.

<sup>14</sup> The amount of seigniorage in 2011/12 is reported to be £851mn (or 0.06% of GDP). However, the vast increase in the monetary base due to quantitative easing suggests seigniorage is now 0.2% of GDP although this is supposed to be temporary until the central bank balance sheet is reduced to a more traditional size.

<sup>15</sup> This is complicated by quantitative easing which massively increased bank reserves at the Bank of England (as well as the many ways of calculating seigniorage).



does not tie the value of its currency to an asset, such as gold or another currency, then it has no commitment to exchange its currency for any other asset.<sup>16</sup> Such a central bank's only liability is a promise to repay the bearer, which could be honoured by repaying creditors with some newly created money. The only limit is that this increase in money does not violate the inflation target. In periods of financial distress when private agents want to hoard the safest asset, central banks' supply of liquidity provides an important safety valve.<sup>17</sup> In the fog of a crisis it is rarely straightforward to distinguish between illiquidity (a central bank responsibility) and insolvency (a fiscal issue). Central banks which provide liquidity can facilitate the transfer onto the fiscal accounts.

The Scottish Government and CBoS would have full responsibility for financial stability. This would include oversight and liquidity management of a Scottish payments system as well as regulation. The CBoS is likely to require banks to hold newly issued Scottish currency bonds in their liquidity requirements. Because the Scottish Government is unlikely to have any risk sharing arrangements with other governments, it will be responsible for any fiscal support which may be necessary. For this reason we would expect to see a 'New Zealand' style banking system with most banks headquartered outside of the country. The big banks currently headquartered in Scotland would likely change domicile to London to be replaced by large subsidiaries in Scotland. This would ease the regulatory burden and remove a potential fiscal liability that the Scottish government could not afford.

A redenomination law would be required, changing most of the existing financial assets into the new currency. This should not be too difficult for households as most loans are under Scots Law, but there may be some challenges to rewriting contracts of large companies in foreign law (including English Law).<sup>18</sup> Government wages, pensions and procurement would need to be redenominated into the new legal tender. Eichengreen's (2007) review of the Argentine experience suggests that it is better to redenominate more rather than fewer contracts. The transition inevitably creates a risk of capital flight. Other countries which have redenominated in recent years (e.g. the Baltic States, Slovakia, Slovenia and Croatia) had much less sophisticated financial sectors.

While Scotland could opt for an arrangement anywhere between a floating and a fully fixed currency, a small open economy putting in place a stabilisation plan would benefit from exchange rate certainty. This would also create an opportunity to accumulate more foreign reserves, establish fiscal credibility and avoid capital flight. The obvious currency to peg the Scots pound to is sterling (perhaps

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<sup>16</sup> See Grauwe and Ji (2013) in the euro zone context.

<sup>17</sup> See Gourinchas and Jeanne (2013)

<sup>18</sup> In most cases the problems ought to be surmountable as an important consideration against any counter-claim is the geographic area where the contract applies.

in combination with the euro and even the dollar).<sup>19</sup> Importantly the weights or peg could be altered by small amounts to make clear that the authorities wish to use the flexibility when conditions necessitate. The CBoS would largely follow the Bank of England's monetary policy, with some room for slight deviation once credibility is established. At the centre of a stabilisation plan would be restrictive fiscal policy.

Re-introducing Scotland's own currency would, over time, bring the greatest discretion over economic policy. The Fiscal Commission Working Group (FCWG) state "in the long run, the creation of a new Scottish currency would represent a significant increase in economic sovereignty, with interest rate and exchange rate policy being two new policy tools and adjustment mechanisms to support the Scottish economy."<sup>20</sup> However, the transition would be a challenge because the Scottish government has no track record in economic management. The stabilisation process is likely to involve at least as much fiscal rectitude as the other options. Introducing a Scottish currency seems to offer more flexibility and yet the transitional arrangements would require a very similar monetary and fiscal stance as the other options. The important advantage of having introducing a Scottish currency is an added element of flexibility to unforeseen shocks and the ability to adjust as the economy evolves.

## **ii. Sterling currency union**

The attraction of sterling for an independent Scotland is that there are few transitional costs, there is familiarity with the existing currency and there would be no transaction costs for exchanges between Scotland and the rest of the UK. These are clear advantages over both the euro and Scots pound options. However, it would be a mistake to confuse familiarity with continuity; after the political break-up of Czechoslovakia in 1993 the plan to continue using the same currency broke down in one month.

Currency unions have a long history, yet there is little agreed formal demarcation with regard to what constitutes a union other than sharing a currency. It is perfectly plausible that a continuing UK and independent Scotland form some sort of a currency union: the crucial point is what the union involves. There have been many different types of currency unions, which fall into the three categories described in Box 2.1.<sup>21</sup> At the centre of each type of currency union is the governance structure and remit of the central bank.

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<sup>19</sup> This would be similar to Singapore's managed exchange rate.

<sup>20</sup> Fiscal Commission Working Group (2013a), p. 123.

<sup>21</sup> See Nugee (2011).

### **Box 2.1 Three models of currency unions**

There are many different forms of currency union. We present a taxonomy based on the size and political relationship of member states.

**Unequal size:** involving two or perhaps three nations of very different sizes. This type of currency union is often for convenience in sharing the same currency in transactions. Because of the difference in size there is little risk sharing or shared influence in setting policy. Examples include the Belgium-Luxembourg Economic Union (1919-1999). The Belgium and Luxembourg francs were fixed at par and legal tender in both countries. However, Belgium was ten times bigger than Luxembourg and the National Bank of Belgium was the central bank for the union. Each state was responsible for its own financial stability and there was no fiscal integration. A similar example is the UK arrangement with its Crown Dependencies who have full fiscal autonomy, are allowed to use sterling with access to the payment system (as currency board type arrangements with deposits held at the Bank of England), but who have no say on monetary policy and separate fiscal and financial support arrangements.

**Equal size:** these are unions between many similar-sized countries so no single country has dominance. A supra-national institution is created either to mint currencies or to act as an international central bank and members generally maintain fiscal autonomy across politically independent states. The most obvious example is the euro area where Germany is the biggest nation but accounts for less than 30% of the zone. Several famous examples have existed in the past including the Austro-Hungarian Empire, the Latin Monetary Union and the Scandinavian Monetary Union.<sup>22</sup> These arrangements involve sharing of currencies but not fiscal policies.

**Within state:** currency unions also exist within national boundaries which coincide with political union. The most widely cited examples are the United States, whose states have some fiscal autonomy, and even the UK which is moving toward greater national fiscal autonomy. Another interesting example in Europe is Switzerland, whose cantons share the Swiss Franc but have a substantial amount of fiscal autonomy. In these rare examples, there is a high degree of fiscal integration and full banking integration. In a sense, the euro zone is trying to replicate the institutions of a within state union.

The scope of central bank powers differs again in a formal currency union. Two or more countries share the same currency but there is a single shared central bank which has some form of joint governance structure.<sup>23</sup> The nature of the currency union depends on the size, number and complexity of the countries involved. Monetary policy decisions are decided under some agreed governance arrangement. In the UK, monetary policy is currently conducted by the Monetary Policy Committee (MPC), an expert committee without regional affiliation and looking at the whole of the UK. A single policy cannot be perfect for all regions, yet there is little visible sign that the one-size-fits-all monetary policy is a persistent disadvantage to Scotland. One of the challenges for a UK currency union is the large difference in size between Scotland and the continuing UK. The FCWG suggests that either a new supra-national sterling zone central bank or the Bank of England continues to operate across both states subject to oversight, accountability and indemnification from two fiscal authorities. It has been suggested that perhaps there could be a Scotland representative on the Monetary Policy

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<sup>22</sup> The Austro-Hungarian Empire (1867-1918) consisted of Austria, Hungary, Czechoslovakia, Romania, Serbia, Croatia and Slovenia. The Latin Monetary Union (1865-1927) initially included Switzerland, Belgium, France and Italy but reached a peak of 14. The Scandinavian Union (1873-1914) consisted of Sweden, Denmark and Norway.

<sup>23</sup> Some form of joint governance arrangement between the two central banks is also possible.

Committee, but this would change the very nature of an expert and non-political committee. In addition, with the continuing UK ten times bigger (by population) than an independent Scotland, it is unclear how this would result in shared responsibility. It is also not clear that one vote could ever exert any more influence than at the margin.<sup>24</sup>

The much bigger issue is the role of the Bank of England in supporting financial stability to financial institutions based in an independent Scotland. There is no reason why UK subsidiaries of Scottish banks would be excluded from liquidity support (they would have good quality sterling assets to post as collateral), but providing support to institutions in another sovereign state or in the UK where there are doubts about solvency could expose UK taxpayers to at least two types of risk emanating from Scotland. First, Scottish banks are likely to be a major buyer of Scottish government debt for their liquidity buffers. Therefore any fiscal problems in Scotland would be transmitted to a banking sector that the Bank of England might be expected to support. Second, it is unclear how a contract could be enforced where one state collects payment for banking sector losses made by a private company based in another state. Certainly the time when a country loses an important financial institution is also the time when the state can least afford to make good on its commitment.

In this form of currency union, the UK would be indirectly exposed to the credit risk of an independent Scotland. To manage this exposure, the UK Government has made clear that it would seek limits on the taxation and spending of an independent Scotland. The nature of the fiscal constraints and whether they can be effective has not been explained. Assuming the constraints are designed to contain credit risk, they could require some deeply unpopular policy choices at the worst time for the economy. In general, the constraints would need to be tighter for countries that have a large existing debt burden and a relatively large banking system. An independent Scotland is likely to have both and therefore the constraints are likely to be intrusive.

Many other countries choose to tie the value of their currency to another currency, or even simply use the currency of another country without formal consent ('dollarization' or an informal currency union, e.g. Panama and Montenegro). These are often small states which rely heavily on trade or larger countries which have had a poor record of economic management. Because the currencies can be swapped at a fixed exchange rate, the overnight official interest rates are the same. The amount of liquidity support the central bank could provide, however, is limited to any excess of assets over its liabilities. In periods of financial distress, if private agents want to hold the safest assets they may choose to exchange the domestic currency in favour of the core currency. A central bank could increase the cost of this exchange by raising interest rates, but at the risk of damaging its own

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<sup>24</sup> One vote would be a population based representation on the MPC.

economy.<sup>25</sup> The scope for liquidity support is in practice limited to assistance to specific firms rather than the whole system.

To sum up, financial stability support in a currency union is challenging, especially with independent regulators. In a formal currency union, this would require a clear and binding assignment of how nations would pay for any losses within their borders, which in turn requires a degree of fiscal integration. Although a formal currency union would be costlier to break-up, if the public decided that the political calculus had moved against the union, capital flight would force the re-introduction of a domestic currency.

### **iii. Euro zone**

The third realistic currency option for Scotland would be to join the euro. Scotland is expected to be an EU member and therefore is very likely to be required to commit to joining the euro.<sup>26</sup> The issue of timing is complicated. The process involves meeting the Maastricht convergence criteria on monetary and fiscal conditions (see Box 2.2). The shortest possible time frame is 2 years, although meeting the sustainable public finance and durable convergence criteria may take many years. Of particular note is the requirement to have a stable currency in an ERM II framework before joining the union. This implies Scotland cannot jump from sterling to the euro but would go through an interim period with its own currency. No country has joined the zone without first having a period of time with its own currency. It is unlikely that Scotland would be allowed to be an EU member and use the euro on an informal basis.<sup>27</sup>

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<sup>25</sup> Sweden famously raised interest rates to 500% in 1992 and successfully supported its currency.

<sup>26</sup> To award a small independent country an opt-out when the rest of the union is moving toward greater integration would seem incongruous.

<sup>27</sup> Montenegro or Kosovo are very small and the circumstances were so exceptional that they were permitted.

**Box 2.2 EU Membership and Currency Implications**

The Scottish Government has indicated that if Scotland becomes an independent nation it will become a member of the EU. The process is unprecedented and therefore uncertain and so the requirements are likely to be negotiated.

If Scotland was outside of the EU then a straightforward process of accession under Article 49 of the Treaty of the European Union would apply. Yet as the UK is an EU member, all existing UK citizens are also EU citizens. Whether and how this changes with Scottish independence depends on the constitutional process of independence in the UK. Given the uncertainty, it is likely that the process and terms of membership would be negotiated and involve a Treaty change (not least because existing EU representation would change).

All EU member states except Denmark and the UK (who have 'opt-out' clauses) are required to commit to adopting the euro as their currency, although the timing is often unspecified. By joining the euro, national monetary policy making is transferred to the European Central Bank (ECB) for the benefit of the whole area. While an independent Scotland may not necessarily be acceding to the EU, because of its lack of economic track record as an independent nation there is a case to be made that it would be treated in a manner consistent with accession countries. It is unlikely that Scotland would be granted an 'opt-out' or that it would be permitted to immediately join the Euro zone. For countries to adopt the euro the European Commission and the ECB must judge that the country has met five convergence (the 'Maastricht') criteria below.

| <b>What is measured</b>     | <b>Price stability</b>  | <b>Sound public finances</b>             | <b>Sustainable public finances</b>        | <b>Durability of convergence</b>  | <b>Exchange rate stability</b>                                       |
|-----------------------------|---|--|---|---|--|
| <b>How it is measured</b>   | Consumer price inflation rate   | Government deficit as % of GDP           | Government debt as % of GDP               | Long-term interest rate   | Deviation from a central rate  |
| <b>Convergence criteria</b> | Not more than 1.5 percentage points above the rate of the three best performing Member States | Reference value: not more than 3% of GDP | Reference value: not more than 60% of GDP | Not more than 2 percentage points above the rate of the three best performing Member States | Participation in ERM II for at least 2 years without severe tensions |

Joining the euro area would involve similar transitional costs and risks as introducing a new currency, although there is greater certainty about the experience of the authorities and clarity about how the system operates. Transaction costs would be higher than for a sterling union although not as high as with the Scots pound. If Scotland joins the euro area the Governor of the CBoS would join the ECB Governing Council and monetary policy would be conducted in the interest of the whole area. Given the trade and financial linkages between Scotland and the UK versus the euro area, monetary policy is less likely to be conducive to the needs of Scotland in the early years after independence. The experience of similar small countries with different economic cycles, notably Ireland, shows the importance of tough financial regulation and active countercyclical fiscal policy.

The EU is also proposing tougher fiscal rules although they are likely to be less intrusive than the restrictions of a formal sterling currency union.<sup>28</sup> That the rules apply to all Member States may mean they are more politically acceptable. Scotland would receive a share of seigniorage based on a population and GDP rule. Greater fiscal integration within the EU is also being discussed, although it is unclear that all Member States have the same view.

If Scotland were to join the euro area, the ECB and European Stability mechanism would provide a ready-made payments system, liquidity operations facilities and possibly even a fiscal backstop in the event of further financial difficulties. The moves toward a banking union may be attractive to the Scottish government. The euro area banking union involves a single super-regulator working with national regulators, a common resolution process and a common deposit insurance programme. If a formal currency union could not be agreed with the UK, the banking union proposals suggest that the euro area might yet become a real alternative.

#### **B. Ranking currency options**

Both the Treasury and the FCWG use the Optimal Currency Area (OCA) framework in their analysis of the alternative currency options.<sup>29</sup> While it may seem obvious that they should therefore both reach the same conclusion - that sterling is the preferred currency option - it is important to note that this is the same answer to two very different questions.<sup>30</sup> The Treasury make the case that the existing UK (including Scotland) is an OCA while the FCWG makes the case that the continuing UK and an independent Scotland together would constitute an OCA. There is no reason why two such fundamentally different questions should yield the same answer. This is an important difference because, as Goodhart (1989) emphasises, a casual look at countries around the world which share a currency generally reflects political boundaries rather than economic criteria. Independence would be a redrawing of political boundaries.

While the OCA framework is a traditional framework, it is notable that the theory does not feature any of the key economic factors at the centre of recent or the current financial crises. Yet according to the IMF there have been 218 currency crises between 1970 and 2011, 65 of which

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<sup>28</sup> HM Treasury (2013a) p64 paragraph 3.53.

<sup>29</sup> HM Treasury (2013a) p14 states 'The standard framework for assessing currency choices is known as the Optimal Currency Area approach. It provides the analytical framework and a set of economic criteria by which to judge the costs and benefits and therefore appropriateness of different currency arrangements'. Fiscal Working Commission (2013b) p2 'It is common practice to begin considering currency options by referring to the work on Optimal Currency Areas'.

<sup>30</sup> The Fiscal Commission Working Group (2013b) has a nuanced position: 'over the medium term it may well be in Scotland's interests to move to an alternative arrangement.'

coincided with sovereign debt crises.<sup>31</sup> The common factors in many of these events are vulnerable private and public sector balance sheets and de-stabilising cross border capital flows. These factors are simply absent from the OCA literature. Moreover, the welfare costs of the economic disorganisation and possible permanent loss in output following currency, financial or sovereign crises far exceed the loss in output due to real exchange rate misalignments.<sup>32</sup> Studies from the IMF and numerous others show that the output losses from recessions involving financial dislocations far exceed the losses from more traditional recessions. For this reason, we consider resilience as the most important criteria by which to judge Scotland's currency options.

#### **i. Optimal currency areas**

The notion of an OCA was developed over fifty years ago and has remained popular despite the vast change in the structure of the global economy.<sup>33</sup> In this framework the main benefit of having a common currency between two regions (either within or across a political boundary) is that it promotes trade through lower transactions costs from fewer currency transactions and greater transparency of pricing. However, the trade-off is the loss of regional monetary policy to address local needs in the event of an adverse economic shock affecting one region and not the other. The framework then presents conditions which tilt the trade-off in favour of a currency union. Mundell's (1961) original contribution introduces three OCA criteria: first, common economic cycles in both countries (so one size of monetary policy fits all); second, wage and price flexibility; and third, labour and capital market mobility to reduce underemployment and wide income differences. Kenen (1969) complemented this approach, recognising that while there are inevitable limits to integration, the extent to which fiscal policy can support demand in different regions can offset imbalances when they occur. However, a shared fiscal policy usually requires political union, as has been illustrated in Europe.

While the OCA framework has remained popular over time, it has limitations. First, it provides a list of criteria without any scale for weighting one criterion against another and so does not demonstrate which circumstances are closer to an OCA. While this may not be problematic for comparing regions in the same country, it makes it difficult to compare countries in different circumstances (e.g. Scotland as part of the union and outside of the union). Second, the empirical evidence showing the benefits of increased trade flows from using the same currency is fraught with

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<sup>31</sup> See Laeven and Valencia (2012).

<sup>32</sup> 'Disorganisation effects' was coined by Blanchard and Kremer (1997) to aid understanding of the output collapse of transition economies.

<sup>33</sup> In 1961 the world was on the gold standard, most cross border capital flows were official flows and financial markets were largely repressed. Between 1950 and 1980 there were almost no systemic financial crises compared to well over 100 systemic crises since 1980.



difficulties (see Box 2.3). Third, as noted above, the application of the framework has usually ignored what little has been said about financial variables.<sup>34</sup> Fourth, the effect of a shared currency on trade flows is clearly important, but this is not the same as a welfare analysis. In other words, bilateral trade flows alone do not tell us how much income (so consumption) will rise or fall.

The impact of a shared currency depends on the countries involved (income levels, degree of integration and historical relationship etc). However, this can be very roughly approximated in two stages: (a) what is the impact on trade, and (b) what is the effect of the trade effect on income. The introduction of the euro provides a useful benchmark. Dell'Ariccia (1999) shows that the elimination of exchange rate volatility between 15 EU states and Switzerland would have increased bi-lateral trade by 12%. Using a different methodology Santos Silva and Tenreyro (2010) compare the increase in trade for the countries which adopted the euro compared to other EU and EEA countries which did not. They find no evidence that adopting the euro had an effect.

If Scotland re-introduced its own currency this would be moving out of, rather than into, a currency union and there is no reason to expect a symmetrical effect. Thom and Walsh (2002) look at the case study of Ireland ending the Irish pound link to sterling in 1979. This is an intriguing case because both countries are members of the EU with long historical ties and there had been no sudden deterioration in relations. They conclude that ending the link 'did not slow the growth of Irish trade with Britain to any significant effect'.<sup>35</sup> The Treasury (2013b) carried out a very different exercise of estimating a possible 'border effect' between the UK and an independent Scotland (using a gravity equation). They estimate that bilateral trade would be approximately 80% lower after 30 years. However, this translates into only a 4% decline in real income over 30 years or 0.13% per year.<sup>36</sup> Even a casual look at other European countries who retain their own currency (e.g. Norway, Sweden, Denmark and Switzerland) do not show obvious disadvantages.

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<sup>34</sup> In fact, Mundell (1961) included a discussion that a larger currency area would result in deeper capital markets which are less susceptible to destabilising speculation. While the idea of deeper capital markets is rarely included in empirical work, it is an important insight we develop below.

<sup>35</sup> Thom and Walsh (2002) p 1122.

<sup>36</sup> HM Treasury (2013b) pp 64-5.

### **Box 2.3: Empirical Estimates of Currency unions**

Estimating the effect of a currency union on bilateral trade is fraught with statistical challenges. Early approaches to this question applied a gravity equation, where trade replaces gravity, which is estimated as a positive function of the size of two economies (replacing the mass of two objects) and a negative function of the square of the distance between two economies (between the two objects). Although the gravity equation was not derived from trade principles, it has apparently high statistical explanatory power. An example of a typical log linearized gravity regression function is shown below.  $T$  shows the bilateral trade between countries ( $i$  and  $j$  in period  $t$ ) as a constant and a function of the size of the countries measured by GDP or  $Y$  (with the restriction  $\alpha_1 = \alpha_2$ ), the distance between two countries  $D$ , a vector of indicators  $X$  which includes factors which might explain two-way trade such as common language, religion, colonial past and common border and an indicator variable  $CU$  which is 1 if countries are in a currency union or zero otherwise and an error term. The  $\beta$ 's are coefficients of interest to be estimated.

$$\ln(T_{ijt}) = \ln(\beta_0) + \ln(\beta_1) \ln(Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2}) + \beta_2 D_{ij} + X_{ijt} \beta_3 + \beta_4 CU_{ijt} + \varepsilon_{ijt}$$

Rose (2000) provided the first large scale estimation and showed that a currency union may result in a 200% increase in trade between the two countries. The size of this result stimulated several subsequent papers which, to a greater or lesser extent, sought to address some of the methodological problems in this procedure. First, joining a currency union is clearly a policy choice and therefore will depend on some factors and so cannot itself be an explanatory variable. If a difficult to measure influence on forming a currency union (for example, culture) also influences bilateral trade, then all of the coefficients are biased. Second, it is unlikely that the error term will be independent of some of the regressors (such as size) and may well have some persistence over time which will invalidate standard tests of statistical significance. Third, the size variable is actually a proxy for bilateral trade as a share of production of tradable goods and therefore measured with error which necessarily biases the coefficient towards zero. Fourth, because the variables are entered in log form, those countries which do not trade together are automatically dropped from the sample (which reduces the sample by around 30%).

#### **ii. A 'hard currency' requirement**

'I don't think we're in Kansas anymore' is the catchy title of Diaz-Alejandro's (1984) review of debt crises in the early 1980s. He noted that the speed and severity of recent crises could not be explained by either external shocks or policy mistakes, but that financial markets had become the central force in the non-linear dynamics of new crises. Old style crises were largely a slow moving spiral of inflation and then devaluation. Dornbusch (2002) describes how financial repression in the 1960s and 70s prevented an excessive build-up of leverage and large cross-border exposures. However, this was displaced by a gradual move to financial openness. New style crises involve doubts about the creditworthiness of national balance sheets leading to capital flight and sudden exchange rate losses. If countries tried to fight against capital flight with higher interest rates, any vulnerability would be cruelly exposed by markets.

A recent IMF paper by Laeven and Valencia (2012) examines banking, currency and debt crises around the world between 1970 and 2011. Two clear messages stand out: first, there has been

a vast increase in the frequency of financial crises; and second, financial crises are extra-ordinarily expensive. The authors record 218 major currency crises of which 37 included sovereign debt crises and 36 included banking crises.<sup>37</sup> Just looking at incidences of banking crises, the average cost in terms of lost output relative to trend in advanced economies is a staggering 33% and on average the public debt to GDP ratio increases by 21.4 percentage points.

The key point is that the welfare consequences of financial crises appear to far exceed the welfare consequences of added currency volatility through decreased trade flows. Therefore, rather than following the OCA approach of prioritising the elimination of currency volatility to promote trade, the priority ought to be on a currency policy which reduces the likelihood of capital flight and therefore promotes a stable currency arrangement. This approach puts more emphasis on capital markets (which clear faster than goods markets) and expectations.<sup>38</sup>

To prevent capital flight, an independent Scotland requires a 'hard currency'. A necessary condition is that it supports the development of long term debt markets which shows citizens and investors are prepared to hold assets denominated in that currency. Creating a 'hard currency' has added urgency as an independent Scotland has to develop capital markets quickly to raise funds to cover its existing deficit and repay its share of existing UK debt (see Section 3). This idea has a long history. Currency is the denomination of money which Hawtrey (1913) defined as a standard value in which to repay debts. A necessary condition for a 'hard currency' is that the sovereign is seen to be solvent. If the government is solvent then it will not default and can issue more debt or currency in the event of adverse circumstances. The global financial crisis has devastated government finances around the world with the outcome that investors are now questioning whether any highly indebted country without access to its own currency can repay its debts.<sup>39</sup>

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<sup>37</sup> Currency crises are defined by a fall in the nominal exchange rate by more than 30% in one year.

<sup>38</sup> These features are captured in the various generations of speculative attack currency models developed from the mid 1980s. See for example, Burnside, Eichenbaum and Rebelo (2001) for an application to the Asia currency crisis.

<sup>39</sup> Reinhart, Reinhart and Rogoff (2012) show the (un-weighted) gross government debt to GDP ratio for advanced countries of 90% in 2011.

### 3. INDEPENDENCE AND ECONOMIC CHANGES

If Scotland becomes independent, its economy will be set on a new course which cannot be known with any certainty. Yet the very act of independence implies some fundamental changes to the structure of the economy. Assets and liabilities must be divided. There are many public assets located in Scotland, but by far the economically most important is its share of hydrocarbon (oil and gas) fields under the North Sea. Scotland would also have to compensate the continuing UK for being relieved of its fair share of the existing UK public debt at the time of independence. This has many interesting dimensions, which carry significant credit risk issues for both nations. An independent Scotland would also need to reconsider some important aspects of its financial markets including the remit of the CBoS, location of international banks and the development of domestic capital markets.

In the event of Scottish independence, the common or public assets and liabilities of the existing UK would need to be divided between the two sovereign states. A critical issue is the basis of this division. Considering the fluidity of international borders, history offers surprisingly few precedents. Where new sovereign states are created after colonialism, civil war or economic collapse there are either few assets and liabilities or a general basis for the settlement. Two recent of potentially 'friendly' separations which offer some guidance are the actual division of Czechoslovakia in 1993 and the possible separation of Quebec in 1995, see Box 3.1 for details. The Czech Republic and Slovakia separated assets on the basis of location (geographic basis) while liabilities were divided on a per capita (population) basis.

#### **Box 3.1: Division of assets and liabilities**

The division of Czechoslovakia into the sovereign states of the Czech Republic and Slovakia in 1983 is often called the 'velvet divorce' for its spirit of mutual agreement. The Czech Republic was the larger state with the central bank and capital markets located in Prague while Slovakia had more natural resource reserves. The general principle was that property and natural resources should belong to the state in which it was situated with other non-physical assets and liabilities divided 2:1 in to the Czech Republic, in line with the relative population size. The amount of debt was relatively small and divided up on per capita basis. See Box 2.2 for a discussion of the capital flight.

In 1995 voters in Quebec had a referendum on whether the province should secede from Canada. According to Chant (1991) prior the referendum four alternative ways of separating the Federal debt were considered. Two measures were per capita (25%) and income (25%) with a Belanger-Campeau formula (21%) based on the government's acquisition of assets, future tax liabilities and pension obligations and the historical benefits from the Confederation of (30%).<sup>40</sup> The low estimate is reported to have been a negotiating ploy by the separatist movement. Since the vote for separation was rejected by 50.6% which measure of debt would have been agreed is unknown.

<sup>40</sup> The figures in brackets are Quebec's proposed share of the Federal debt.

## A. Scotland as a net exporter of hydrocarbons

By far the most important physical asset to be divided would be the oil and gas fields under the North Sea. The output from the fields is sold onto world markets and, under current accounting conventions, the output does not enter into the estimates of output for any actual region of the UK but designated to an *extra-regio* (hypothetical region). The importance of oil and gas to an independent Scottish economy should not be underestimated. It is clearly a large and valuable asset, but its volatility raises challenges in terms of managing that volatility which also has implications for the currency choice. It is estimated that there are around 2,000 firms in the oil and gas supply chain in Scotland and a total of 200,000 jobs or 8% of employment in total in Scotland are related to North Sea activities.<sup>41</sup> According to the Scottish Government, the oil and gas sector is the largest industrial sector in Scotland.<sup>42</sup> The tax revenues from the sale of oil and gas are currently collected by HM Revenue and Customs. The amounts involved are certainly large. Over the past five years the average tax revenue from oil and gas has been £9.4bn.<sup>43</sup> While this is equal to only 1.6% of onshore tax revenues for the UK in 2011-12, if all of the revenue had been awarded to Scotland this would have accounted for 20% of onshore tax revenues.

Most oil and gas experts expect that a geographical basis using a median line is likely to be the starting point in negotiations as this has been used in negotiations over North Sea rights between the UK and other countries. While there is some dispute over exactly where the line should be, a consensus is that this would give Scotland approximately 90% of the oil and gas reserves. There is a great deal of uncertainty on the value of the tax revenue to the government as this will depend on some combination of the remaining reserves, oil price, exchange rate, investment costs and decommissioning costs. The Office of Budget Responsibility (OBR) recently lowered its revenue forecasts due to weak production figures. Its central forecast between 2019FY and 2041FY is for a cash sum (i.e. not discounted) of £56bn (of which 90% would be £50.4bn in cash terms).<sup>44</sup> Clearly the tax benefit to Scotland is mirrored by a tax loss to the continuing UK.

That the tax revenue for the remaining oil and gas reserves is difficult to forecast makes the volatility of the revenues an important issue for fiscal planning purposes. For example, between 2008/09 and 2009/10 North Sea tax revenues fell from £12.9 billion to £6.5 billion, partly as a result of the global recession. This would be equivalent to a nearly 5% deterioration in tax revenue as a share of GDP for an independent Scotland without considering the second round effects on taxes from the rest

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<sup>41</sup> Scottish Government (2013) p9-11.

<sup>42</sup> Scottish Government (2013) p9.

<sup>43</sup> Government Expenditure and Revenue Scotland 2011-12, Table 4.1.

<sup>44</sup> These figures could change significantly depending on progress with shale gas extraction.

of the economy. If the government were to stick to its budget, this would mean either an additional 5% of GDP in tax revenue or less spending would need to be implemented for that year. If tax and spending plans were to be maintained, then the fiscal balance could change by 5% of GDP as a consequence. The OBR's range of estimates for the remaining tax revenues based on a high and low scenarios for prices of £82bn to £43bn and production £73bn to £40bn.<sup>45</sup>

The importance of hydrocarbons to an independent Scotland also matters for the choice of currency. As MacDonald (2013) reminds us, Scotland may not currently have its own exchange rate, but it has always had its own real exchange rate (domestic price index relative to foreign price index for the same goods).<sup>46</sup> Since an independent Scotland would be an oil and gas exporter with tax receipts a function of energy prices and a large industrial hydrocarbons industry, part of the price index will be connected to the price of oil and gas. While an independent Scotland would be a large net exporter of hydrocarbons, the continuing UK would remain an importer of hydrocarbons.

One of the conditions of the OCA discussed in Section 2 is that regions have similar structures and therefore would face similar shocks, so a one-size-fits-all monetary policy would not be too costly. Independence will change Scotland's economic structure and hence be a step away from the ideal of an OCA. Consider a concrete example. Suppose the world oil prices rose sharply due to geopolitical events in the Middle-East: this would be economically beneficial for Scotland, supporting its balance of payments, easing its fiscal constraint, leading to more investment in oil extraction and creating more demand in the largest industrial sector. But at the same time, this would worsen the balance of payments in the UK and lower domestic demand. Under most governance arrangements for the Bank of England, this scenario would be more likely to lead to lower rather than higher interest rates. This would be the opposite response to what would be needed in Scotland. Having lower interest rates at a time that the economy is growing strongly would add to the real exchange rate appreciation.

Over time the real exchange rates of Scotland and the UK are likely to diverge. If energy prices are higher, Scotland's real exchange rate will appreciate, which McDonald (2013) suggests may have consequences for the non-energy related sectors in the economy. As resources are diverted to the oil and gas sector and away from the wider economy this may lead to higher labour costs in the rest of the

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<sup>45</sup> The OBR projections are lower than the Scottish Government projections to 2018.

<sup>46</sup> Formally,  $e = E\left(\frac{P}{P^*}\right)$  where lower case is the real exchange rate and the asterisk denotes foreign price level. Real exchange rates are usually calculated against many countries weighted by the share of trade to generate a real effective exchange rate.

economy.<sup>47</sup> This is a variant of the so-called ‘Dutch disease’ that particularly applies to countries with a large share of natural resources sold on world markets.<sup>48</sup>

## **B. Scotland as a net debtor**

Since the Union was created, all citizens of the UK have benefited to a greater or lesser extent from the services and investment provided by the state. Much of this spending has been financed by borrowing from private citizens and all citizens are required to pay their due taxes to service and repay the national debt. If Scotland becomes independent, the new Scottish state would be required to compensate the continuing UK state for being relieved of (i.e. no longer obliged to pay) its share of outstanding UK public debt at the point of independence.<sup>49</sup> This compensation is not a straightforward matter and raises at least three important questions, the answers to all of which greatly influence the robustness and sustainability of some of the currency options discussed in section 2 as well as the credit standing of both states.

- Which measure of UK public sector debt is appropriate?
- How would the public sector debt in 2016 be divided?<sup>50</sup>
- How would an independent Scotland compensate the UK?

### **i. Which measure of debt?**

The Public Sector Net Debt (PSND) is the most commonly cited measure of public debt in the UK. Fiscal rules set by past and the present governments use the PSND definition of debt and credit rating agencies widely cite similar measures when judging the creditworthiness of sovereign states. It is defined as the total issued financial liabilities (government bills and gilts and National Savings debt) minus liquid assets (foreign exchange reserves and cash deposits) measured on a cash basis (so without accruals). Note, that this measure now includes many cash flows from the financial sector interventions (including interest earned from quantitative easing) but excludes the mark to market cost of the equity investments in the Royal Bank of Scotland and Lloyds Bank Group which would add approximately

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<sup>47</sup> It is unlikely that the nominal exchange rate would fall to fully offset the consequences of the energy price rise because its impact would be much greater in Scotland due to the relative importance to its economy.

<sup>48</sup> The Dutch disease is named after the Dutch economy where the discovery of natural gas in 1959 led to an exchange rate appreciation.

<sup>49</sup> At the creation of the Union in 1707 a payment was made to Scotland called the ‘Equivalent,’ which was compensation for becoming party to England and Wales’s unfunded public debt.

<sup>50</sup> According to the Scottish Government if the referendum motion is passed, it will take two years for independence to commence, hence the relevance of 2016.

£20bn to the debt if crystallised in March 2013.<sup>51</sup> The OBR projects that the PSND will be £1,186bn or 75% of UK GDP this fiscal year ending in March 2013 and rise to £1,580bn or 86% of UK GDP in 2016/17.

There are however, alternative conceptual measures of debt which may be more appropriate. The PSND is a cash amount which excludes known future liabilities from past government actions, for example public sector pensions (e.g. to nurses, police and civil servants), decommissioning costs of nuclear power stations and private finance initiatives. According to the OBR's Whole Government Accounts these known future liabilities add £241bn to the PSND in the last financial year. To be clear, including the cost of services which have already been consumed but not paid for would add 20% to the public sector net debt. This does not include contingent liabilities (low probability but specific events) which can be considered as insurance programmes provided by the state. For example, deposit insurance is ultimately a contingent liability of the state.

The main assumption in this paper is that Scotland becomes an EU member and commits to joining the euro zone at some unspecified future date. The assessment of Scotland's fiscal position and its progress towards joining the euro area will be measured by the Maastricht definition of debt. The OBR projects the Maastricht definition of UK net public debt at 101% of GDP in 2016/17 (currently £296bn higher than the PSND). We use the Maastricht criteria for debt in this paper to be consistent with the main assumption that Scotland becomes a member of the EU, although the PSND equivalent figures are also reported. No contingent or future liabilities are included. Of course, when investors assess the solvency of a government, they are certainly not limited to official definitions.<sup>52</sup>

## ii. **Division of Debt**

How the debt is divided between an independent Scotland and the continuing UK is of critical importance and is likely to be keenly negotiated. There are surprisingly few precedents of peaceful and neither post-colonial or post-communist country splits to offer guidance. Box 3.1 reviews the actual division of debt in the Czech Republic and Slovakia separation basis and the alternatives being considered ahead of the Quebec Referendum in 1995. The most transparent way to divide the debt is either on a population basis or an affordability (or GDP) basis because both measures are known.<sup>53</sup> On a population basis Scotland would receive 8.4% of the agreed amount of outstanding debt when it becomes independent. On an affordability basis, there is an issue of whether it is pre or post

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<sup>51</sup> The stock of bonds held at the Bank of England under the Quantitative Easing programme cannot be netted-out because the intervention is supposed to be temporary and will eventually be unwound.

<sup>52</sup> See Burnside, Eichenbaum and Rebelo (2001) for an application of contingent liabilities in the Asia crisis.

<sup>53</sup> Article 5 of the Anglo-Irish Treaty for the creation of the Irish Free State states that the UK's obligations should be divided fairly. However, in the following three years it was recognized that the damage to Ireland presented a major risk to stabilizing the new sovereign state. Article 5 was superseded three years later in 1925.



referendum GDP that is relevant.<sup>54</sup> Since affordability is a forward-looking concept, we use post-referendum GDP, which of course depends on the apportionment of hydrocarbons. On this basis GDP per capita would be significantly higher in independent Scotland hence the larger apportionment of debt relative to population basis.

The various debt share permutations are presented in Table 3.1. According to the OBR, the PSND in 2016/17 will be £1,580bn and the public debt on the Maastricht basis in 2016/17 will be £1,820bn.<sup>55</sup> The top half of the table shows the debt burdens if the total debt figures are divided on a population basis. The two debt burdens for each country show the burden if hydrocarbons are divided on a population basis or geographic basis. For example, 74% refers to PSND debt split on a population basis divided by GDP where oil and gas output is split on a geographic basis.<sup>56</sup> The lower half of the table carries out the same exercise if the debt is split on an ‘affordability’ basis using post-referendum GDP (where oil and gas are divided on a geographic basis).

Table 3.1: Hypothetical debt burdens

|   | Total | UK ex Scotland |            |            | Independent Scotland |           |            |
|---|-------|----------------|------------|------------|----------------------|-----------|------------|
|   |       |                | Debt/GDP % | Debt/GDP%  |                      | Debt/GDP% | Debt/GDP%  |
| 2016/17   | Debt  | £bn            | Pop basis  | Geog basis | £bn                  | Pop basis | Geog basis |
| <b>Debt divided on per capita basis</b>           |       |                |            |            |                      |           |            |
| PSND  | 1580  | 1447           | 87%        | 89%        | 133                  | 88%       | 74%        |
| Maastricht  | 1820  | 1667           | 101%       | 102%       | 153                  | 102%      | 86%        |
| <b>Debt divided on GDP (geographic oil basis)</b> |       |                |            |            |                      |           |            |
| PSND  | 1580  | 1424           | 79%        | 87%        | 156                  | 104%      | 87%        |
| Maastricht  | 1820  | 1640           | 91%        | 101%       | 180                  | 120%      | 101%       |

Sources: OBR (2013a), OBR (2013b) and Government Expenditure and Revenue Scotland (2013)

The first observation is that all of the debt figures are very high. Using the Maastricht definition of public debt and divided on a population basis, and assuming that an independent Scotland is awarded a geographic share of hydrocarbons, the debt burden (debt to GDP ratio) is 86%. This figure is used throughout this paper. The second observation is that assuming the debt is divided on a population basis, the debt burden of an independent Scotland is lower than the UK (which rises marginally).

<sup>54</sup> Because GDP per capita is very similar in Scotland and the rest of the UK using a pre-referendum measure of GDP would be almost the same as using the population basis as above.

<sup>55</sup> Maastricht debt is gross and so excludes public corporations and liquid assets.

<sup>56</sup> Note, this is the same figure as contained in Fiscal Commission Working Group (2013) on page 171.

The Scottish Government has provided another calculation of debt shares which they call an ‘historic’ basis.<sup>57</sup> This is the sum of borrowing assuming that a geographic share of tax revenues from North Sea oil and gas are allocated to Scotland less debt repayments over the past. The Scottish Government has an experimental data series showing the time series since 1980. Using this ‘historic’ basis and assuming a geographical split of hydrocarbons, Scotland’s debt burden would fall to 38% of GDP. There are two issues with this approach. First, is it reasonable to retrospectively allocate tax revenue from oil and gas and not retrospectively allocate taxpayer exposures to banks? Second, the starting point is arbitrary. There is at least some evidence from economic historians that Scotland has been the main beneficiary of the Union.

### iii. **Transfer of Debt**

Once the definition and an appropriate division of debt are agreed, the next problem is how to compensate the UK such that taxpayers in an independent Scotland are no longer responsible for UK debt. Taking the Maastricht debt definition discussed above, this means that the Scottish government somehow makes a payment to the UK government for £153bn in 2016/17. Obviously this sum of money is not immediately available so the issue becomes how can this payment be effected. If this issue is unresolved in the run-up to the referendum, there is a chance that the credit standing of both states would be damaged.<sup>58</sup>

The FCWG (2013) make three proposals, the most plausible of which would see the Scottish government commit to paying the interest and capital repayment of the agreed amount of debt pro-rated across the current yield curve.<sup>59</sup> However, the UK economy would contract by almost 10% (assuming geographic share of debt) and yet it would still be legally responsible for all of its outstanding debt, although it will have an agreement with a foreign government. In effect, its debt burden would rise by 10 percentage points to 97% on a PSND basis or 111% on a Maastricht basis. This may attract the interest of credit rating agencies, see Box 3.3 for a historical example. Moreover, it is difficult to see how the UK could enforce payment post independence. This need not be a deliberate no payment policy, but in some circumstances it is conceivable that an independent Scotland might struggle to issue its own bonds and therefore could not make payment. Cross-border agreements are notoriously difficult to enforce.

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<sup>57</sup> See Scottish Government (2013c).

<sup>58</sup> Chant (1991) discusses this problem ahead of the Quebec referendum “the credit ratings of both Canada and Quebec would be lower than Canada’s is now because of the reduced opportunity for diversification.”

<sup>59</sup> The ‘implausible’ suggestions were to alter terms on existing debt (a default) and issuing jointly guaranteed debt (without seniority it is difficult to see their attraction). An example of the ‘plausible’ suggestion is if the UK has 20% of its debt stock in long-dated gilts and the agreement is that Scotland repays 10% of the debt then it would pay the interest and principle of 2% of long dated gilts to the UK.

The Scottish government would have to issue 86% of bonds quickly if the UK is not to be exposed to Scotland's credit for possibly decades after independence. Perhaps the only way to resolve this dilemma is an asset for debt swap discussed in Box 4.1.

### **Box 3.3 Sovereign Bonds and the Break-Up of the Netherlands and Belgium**

Peaceful break-ups between countries are rare events. The Czech and Slovak velvet divorce is one example, discussed in Box 3.1, although there was little debt. An example of a relatively peaceful state secession is the case of Belgian independence from the Netherlands in 1830. A recent paper by Collet (2013) examines the impact of this break-up on the yields of *both* Belgian and Dutch sovereign debt. This case study is of interest as it suggests that the interest payments of both countries (here the UK) might be adversely affected. This takes on added importance due to the currently high levels of UK government debt.

Collet (2012) identifies two separate types of risk premia on the sovereign debt of countries in the throes of divorce. The first concerns the instability and lack of borrowing track record of the newly independent seceding state, in this case Belgium. Collet (2012) finds that the premium is very substantial: In the first decade after independence, Rothschilds, the premier sovereign bond issuer of the era, issued Belgian debt at a discount of between 9.7% and 26.5%.

The second source of risk premium affects the state left behind, in this case the Netherlands. Collet (2012) estimates that this 'country break-up' risk premium was 143 basis points, and relates it to the uncertainty facing the Netherlands about whether and how much of the national debt the newly independent Belgium would agree to take on. This issue was indeed subject to several rounds of negotiation, and was not finally settled until 1842, twelve years after Belgium had declared its independence in 1830. This suggests that it may also be in the remaining UK's interest to resolve any uncertainty surrounding the division of its national debt sooner rather than later.

### **C. Financial system and independence**

An independent Scotland may require a different structure of financial system. While this presents some real challenges, there are also opportunities to improve on the UK's current system. The Bank of England is constituted and regulated under acts of UK Parliament and therefore any change would require agreement of the UK. An independent Scottish government may have a claim to some parts of the Bank's balance sheet, such as a population share of foreign reserves and even the notes backing the current Scottish currency in circulation (see section 2).<sup>60</sup> Yet the real value of the Bank of England is the taxpayer support behind the institution. It is difficult to see how this support would extend to a foreign country without a formal agreement with the UK government.

UK subsidiaries of Scottish banks would continue to have access to lender of last resort facilities at the Bank, as do other European banks. It is also feasible that the lender of last resort facility could, in exceptional circumstances, be extended to Scottish banks in Scotland (effectively an offshore sterling

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<sup>60</sup> These would need to be negotiated. Apart from physical and intangible assets the financial assets match liabilities (including capital) and so claims on the assets would presumably be matched by equal liabilities.

market) because the lending is fully collateralised and at penalty rates. However, Emergency Liquidity Assistance given to banks thought to be solvent but known to be at risk requires the consent of the Chancellor of the Exchequer. Without a special agreement between the two governments, it is difficult to see how taxpayers in one country could be expected to support institutions in another sovereign state, particularly when regulated outside of the UK.

There are important questions about whether such an agreement would be in the interests of an independent Scotland. If the UK agreed to a formal currency union, it would be the dominant partner and so on judgement calls would have discretion over whether to commit taxpayer funds to help an institution in a foreign state. Moreover, implicit in this idea of forming an agreement is the idea that too-big-to-fail would be permitted to continue. If international banks remain in a smaller state with little fiscal space, the evidence from Europe suggests that depositors would be quick to assess their options. Alternatively, if the CBoS decided to have an informal sterling currency union without any agreement with the UK, it would not be able to provide liquidity support to its banks. The liquidity support problem can be overcome if the Scots pound is introduced. This may be an opportunity to move towards a banking system consistent with the size of the state.

An independent Scotland would also have to develop capital markets. First, a significant amount of bonds would need to be issued as part of its UK debt repayment. These would have to be attractive for residents to wish to hold a significant amount in their pension savings. Second, very large amounts of gross capital flows are difficult for any central bank to monitor and manage. Without developing domestic equity and perhaps securitisation markets, the savings of Scots would have to be invested in foreign markets. Countries that rely on a large volume of cross border capital flows have found them to be less robust than domestic savings. Central banks have found in recent years that it may be necessary to be the “buyer of last resort” in exceptional circumstances, which would require the CBoS to be able to create liquidity.

#### 4. HARD CURRENCY AND FISCAL SUSTAINABILITY

Section 3 presented alternative debt sharing possibilities between an independent Scotland and the continuing UK. Even excluding any contingent liabilities, a division of debt by per capita or affordability is likely to result in Scotland inheriting a debt burden of 86%. To raise this amount of money by issuing bonds requires that investors are prepared to hold assets denominated in that currency. Currencies which investors are prepared to hold as a long term store of value are colloquially known as ‘hard’ currencies. A necessary condition to become considered a ‘hard’ currency is that the solvency of the sovereign is beyond doubt.

Solvency means simply that assets are worth more than liabilities. As explained in Section 2 the solvency condition of a central bank depends on the country’s currency regime. It follows that the solvency condition for the whole government (including the central bank) also depends on the currency regime. This link between currency policy and the government’s solvency condition has played a decisive part in deciding which highly indebted countries are exposed by capital flight. Table 4.1 provides a very crude illustration.<sup>61</sup> Two countries, Spain and Italy, which issue euro denominated debt and have high debt burdens have much higher interest rates than say, Finland which also issues euro denominated debt but has a much lower debt burden and so has a much lower interest rate.<sup>62</sup> The three countries which issue debt denominated in their own currencies have much lower interest rates despite equally high (or higher) debt burdens.

**Table 4.1: Net debt to GDP and interest rates for domestic and foreign currency use issuers**

|                               | Debt to GDP | Current interest rate | Peak interest rate |
|-------------------------------|-------------|-----------------------|--------------------|
| <b>Foreign currency debt</b>  |             |                       |                    |
| Spain                         | 74.1%       | 4.65%                 | 7.43%              |
| Italy                         | 127.7%      | 4.39%                 | 6.35%              |
| Finland                       | 61.2%       | 2.14 %                | 2.14 %             |
| <b>Domestic currency debt</b> |             |                       |                    |
| US                            | 97.6%       | 2.71%                 | 2.74%              |
| UK                            | 90.0%       | 2.57%                 | 2.45%              |
| Japan                         | 211.7%      | 0.79%                 | 0.96%              |

Source: OECD and Bloomberg. Net debt to GDP ratios at 2011. Interest rates are ten year government bond yields as at 1<sup>st</sup> September 2013 and peak is in the twelve months prior to that date.

The difference between currency regimes can also be seen in the differences in countries’ formal solvency conditions. For countries like the UK which issue their own currency, the amount of annual borrowing or increase in debt  $D_{t+1} - D_t$  each year is equal to interest payments on last year’s

<sup>61</sup>This small sample is a crude comparison as there are so many other dimensions along which these countries are very different.

<sup>62</sup> Arguably, it has only been through the ECB’s exceptional Outright Monetary Transactions which brought the peak in interest rates down to current levels.

outstanding debt  $r_{t+1}D_t$ , minus the primary fiscal surplus (the excess of government revenues over expenditures excluding interest payments)  $X_{t+1}$  and the seigniorage  $S_{t+1} = M_{t+1} - M_t$  finance.<sup>63</sup>

$$D_{t+1} - D_t = r_{t+1}D_t - X_{t+1} - S_{t+1} \quad (1)$$

This debt evolution equation describes how total borrowing (including seigniorage) determines debt levels. Taking the path of debt over many years into the future generates a condition in terms of debt today in equation 2. This states that the initial debt today  $D_t$  is equal to future revenue in the form of either primary fiscal surpluses  $X_{t+j}$  or seigniorage  $S_{t+j}$  where  $r$  is a constant interest rate. The second condition in equation 3 states that the debt cannot keep increasing forever.<sup>64</sup> This transversality condition is crucial. It states that debt cannot spiral out of control if solvency is being met, but it does not imply that debt must converge to zero.<sup>65</sup>

$$D_t = \sum_{j=1}^{\infty} (1+r)^{-j} E_t (X_{t+j} + S_{t+j}) \quad (2)$$

$$\lim_{j \rightarrow \infty} (1+r)^{-j} E_t D_{t+j} = 0 \quad (3)$$

Two further points are worth noting. First, the role of expectations is crucial. All of the primary surpluses and seigniorage occur in the future, and so depend on many unknown circumstances. Therefore they are based on an expectation  $E_t$  from the information available today. Second, while the transversality condition is often assumed to be met, market conditions can change quickly. For example, an expectation of losses in a banking sector may lead investors and citizens to assume these will be absorbed by the government and so revise their expectations of the future debt path even though the current fiscal accounts have not changed.<sup>66</sup>

The solvency conditions for countries which issue their own currency and countries which either tie or use the currency of another country differ in subtle ways. A country with its own currency such as the UK can stabilize its debt by either running primary surpluses or printing money to generate seigniorage as long as this does not create (too much) inflation. In a currency union, the solvency condition is somewhat different. Recall that in Section 2, the liabilities of the central bank are tied to the value of its assets through the fixed exchange rate (of 1:1 in the case of the euro). These central banks cannot resort to using seigniorage to fund government spending. They have no access to inflation finance. This is not to say that the money supply cannot increase, but that it must be matched by a

<sup>63</sup> See section 2 for a definition of seigniorage.

<sup>64</sup> A full derivation of the two solvency conditions is presented in an Annex.

<sup>65</sup> Equation (3) is the transversality or no Ponzi scheme condition. A Ponzi scheme, such as that run by Madoff, pays off old debt by taking on new debt, and debt levels grow without bounds.

<sup>66</sup> See Burnside, Eichenbaum and Robelo (2001) for an accurate assessment of how expected bank losses were incorporated into public debt estimates during the Asia crisis.

change in the value of foreign currency assets, to ensure that the domestic money can always be converted into foreign assets at the target exchange rate. This can happen by a country running a balance of payments surplus and so accumulating foreign assets which are matched by an increase in domestic money (to prevent the exchange rate appreciating). Therefore there is still a form of seigniorage, but which must be matched by an increase in foreign assets rather than to finance domestic spending.<sup>67</sup> Therefore, when using the currency of another country,  $S_{t+i}$  can be redefined as balance of payment surpluses.

The government's solvency condition when using another currency is more restrictive than when using its own currency. Equation 2 states that for a country borrowing in its own currency government debt today is equal to the expected discounted income from future primary surpluses and seigniorage. For a country borrowing in a foreign currency which it cannot create, government spending cannot be financed by seigniorage. Although the ECB distributes seigniorage revenues to its member countries, no single member of the Euro zone can print Euros to finance its expenditure. Likewise, in case of a currency union with the UK, Scotland might receive some seigniorage revenue from the Bank of England, but this would be an agreement and not under Scotland's control.

#### **A. Estimating borrowing costs**

The main drivers of the debt level over time in a currency union are primary surpluses and the costs of debt service. The higher is the interest rate on a country's debt, the larger the surpluses it must run to pay its debts. The governments' borrowing costs are clearly an important variable. Yet as there is no separate Scottish government debt, there is no market interest rate. One way to estimate a hypothetical interest rate involves benchmarking against other countries<sup>68</sup>. A market interest rate can be decomposed into a real return, compensation for an expected rise or fall of the currency and a residual of credit and liquidity risk. For small open economies the real interest rate is taken as equal.<sup>69</sup> If interest rates are compared across countries using the same currency, any difference must be either an expected change in the future currency regime or differences in sovereign credit and liquidity risk.<sup>70</sup>

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<sup>67</sup> Another way to consider this is that the seigniorage under a fixed currency regime is hypothecated revenue for increasing foreign exchange reserves.

<sup>68</sup> Goodhart (2012) looks at the difference in bond spreads between the Basque region of Spain and Spanish government bonds. The Basque region is allowed to issue its own debt (subject to agreement with the Spanish Government), it is much richer in per capita terms and is more fiscally conservative (12% debt to GDP ratio). Yet since 2009 Basque debt has traded at a 1% premium over Spanish debt. This has recently widened to 4%. However, the Basque country has also suffered a substantial degree of political instability due to the ETA, an armed separatist movement, which may be an additional source of risk premium.

<sup>69</sup> This is an arbitrage condition.

<sup>70</sup> The difference in sovereign yields across the euro zone can no longer be considered to be fully exempt from currency risk.

Estimating a possible bond yield for an independent Scotland requires three steps. First, to estimate a model of sovereign yield spreads for countries which share the same currency, second, to apply the parameters to Scotland to generate a hypothetical sovereign yield spread and, third, applying this spread to the existing UK government bond yield. Clearly there are some large implicit assumptions such as the model for sovereign yield spreads applies equally to Scotland, that a currency union between Scotland and the UK would be credible and include an ECB like shared central bank. The final assumption suggests that the estimated spreads are a lower bound.

A model of risk premia versus Germany is formulated to include a range of variables which capture the country's ability and willingness to repay its debts.<sup>71</sup> From the discussion above, the amount of government debt and the fiscal balance are required. An additional variable to include would be the current account balance, to capture competitiveness and dependence on foreign investors.<sup>72</sup> However, there is not a current account balance for Scotland, and so we cannot include it as a variable in our baseline model. We do run an alternative specification including the current account balance in the Annex assuming that it is the same as the UK. The size of the government bond market captures liquidity, the ease with which bondholders will be able to find a seller at any given time. Since the government's ability to pay back its debts depends upon the taxes it can collect, the volatility of tax revenue flows is included. The regression equation is:

$$Spread_{i,t} = \beta_0 + \beta_1 \cdot \frac{Debt}{GDP_{i,t}} + \beta_2 \cdot \frac{Deficit}{GDP_{i,t}} + \beta_3 \cdot Liquid_i + \beta_4 \cdot TaxVol_i + controls + \varepsilon_{i,t}$$

The controls capture that the borrower's business cycle stance and the world business cycle might influence borrowing costs, also interacting with fiscal variables. For example, deficits during a downturn might be viewed as cyclical rather than structural, and might not be interpreted by bond markets as a sign of long-run inability to repay debts. See Annex 1 for full specification and results.

The second stage is to use the parameters from the euro zone procedure to estimate the risk premium that Scotland might face using projections on Scotland's government debt, government deficit, volatility of tax revenues and size at independence in 2016, and assuming that Scotland obtains a geographic share of oil. The full assumptions used are summarised in Box 4.1. The implications for Scotland's sovereign yield spreads are presented in Figure 4.1, supported by Table 4.2. Figure 4.1

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<sup>71</sup> The regression run here is similar to that of Bernoth, von Hagen and Schuknecht (2004), "Sovereign Risk Premia in the European Government Bond Market," ECB Working Paper No. 369.



presents the long-run borrowing costs for Scotland, expressed both as a spread over Germany and over the UK. The estimated spread over Germany is 2.12% while the estimated spread over the UK is 0.72%.

**Table 3.2: Scotland in a Currency Union**

| Source of Spread | Spread vs Germany (basis points) | Spread vs UK (basis points) |
|------------------|----------------------------------|-----------------------------|
| Debt-GDP         | 22                               | 0                           |
| Deficit-GDP      | 97                               | 4                           |
| Liquidity        | 84                               | 63                          |
| Tax Volatility   | 9                                | 9                           |
| Total Spread     | 212                              | 72                          |

**Box 4.1: Assumptions for an independent Scotland (and Germany)**

Estimates for a hypothetical independent Scottish bond yield spread relative to Germany are based upon the following baseline assumptions about Scotland’s fiscal position at independence, tax yield volatility and size at independence in 2016:

- Scotland receives a geographic share of oil and a population share of UK government debt which the OBR estimate to be 100.8% of UK GDP, based on a Maastricht definition. On this basis Scotland’s initial debt would be 85.6% of its GDP;
- Fiscal deficit is 3.9 % of GDP, the average for 2000-12 from Scottish Government (2012a) where Scotland includes a geographic share of oil;
- Tax yield volatility is 3.6%, measured as the standard deviation of total tax revenue including a geographic share of oil as a share of GDP from Scottish Government (2012a) for 2000-12;
- Population is 5.2 million or 1.6% of the euro zone.

As all variables are expressed as a spread to Germany, we also make the following assumptions about Germany’s fiscal position:

- Government debt is 73% of GDP, as projected for 2016 by the German Finance Ministry;
- Budget deficit is its long-run average over 2000-12, 2.0% of GDP;
- Tax yield volatility is its 2000-12 average of 2.2%;
- Population is 81.8 million or 25.6% of the euro zone.

The third step is to add the estimated spreads to the appropriate base country bond yield. If we add the Germany-Scotland spread to the long-run average value of 3.63% for German 10-year bond yields, we obtain an estimate of 5.75% for Scotland’s 10-year bond yields, its estimated cost of borrowing. If we add the UK-Scotland spread to the long-run average value of 4.10% for UK 10-year bond yields, Scotland’s cost of borrowing would be 4.82%. To summarize, the estimated 10 year bond

yield has a lower bound of 4.82% and an upper bound of 5.75%. Because the lower bound requires two estimation procedures, there is greater statistical precision over the upper bound estimate<sup>73</sup>.

## B. Fiscal consolidation in a currency union

Throughout this paper it is assumed that an independent Scotland would be a member of the EU which would require some commitment to joining the euro in future and conditional on meeting the Maastricht criteria (see Box 2.2). The most challenging targets are the ceiling of 60% government debt to GDP ratio and 3% on the deficit to GDP ratio. These criteria were conceived of as targets that would ensure that fiscal plans were consistent with sustainable debt levels over longer horizons.<sup>74</sup> For a newly independent country, this provides a reasonable framework for consolidation to create some fiscal slack as insurance against an unforeseen shock (such as a sharp fall in oil prices or new recession) which would worsen the deficit and debt burdens and possibly even raise solvency concerns. An adjustment to a lower debt ratio over a ten year horizon is a moderate consolidation plan.

This framework enables us to consider some future debt burden targets and, given the model for interest rate spreads, to back-out what this implies for a fiscal adjustment. If the degree of adjustment is considered to be unachievable, or the Government fails to produce a credible plan for delivering this broad adjustment, then investors and citizens might doubt whether there will in fact be any meaningful reduction in the debt burden. If there were to be no reduction, this would leave the currency regime vulnerable in the event of an adverse shock.

The debt target is expressed as a share of nominal GDP. Intuitively, if nominal GDP rises relative to debt, then there are more resources in the economy that can be drawn upon to pay down the national debt. Hence, both higher real GDP growth and higher inflation help to achieve a lower debt to GDP ratio. To show how this works, both sides of equation (1) are divided by nominal GDP  $P_t Y_t$  to generate equation (4) where  $d_t \equiv \frac{D_t}{P_t Y_t}$  is the debt-to-GDP ratio,  $x_t \equiv \frac{X_t}{P_t Y_t}$  is the primary fiscal surplus as a share of GDP,  $s_t$  is seigniorage as a share of GDP, while  $\pi$  is the constant rate of inflation and  $g$  is the constant rate of real GDP growth.

$$d_{t+1} - \frac{d_t}{(1+\pi)(1+g)} = r \frac{d_t}{(1+\pi)(1+g)} - x_{t+1} - s_{t+1} \quad (4)$$

<sup>73</sup> That translates into a range of spreads of 72 to 165 basis points over UK borrowing costs.

<sup>74</sup> Note that the debt burdens of the Scandinavian economies are around half the Maastricht criteria levels.

Equation (4) can be converted into a condition linking the initial debt-to-GDP level  $d_t$  and the average primary surpluses  $\bar{x}$  to the future debt level  $d_{t+J}$  at any given date J.<sup>75</sup> where the rate of interest on debt  $1 + \tilde{r} = \frac{1+r}{(1+\pi)(1+g)}$  is adjusted to take real GDP growth and inflation into account.

$$\bar{x} = d_t \frac{1}{\sum_{j=1}^J (1 + \tilde{r})^{-j}} - d_{t+J} \frac{(1 + \tilde{r})^{-J}}{\sum_{j=1}^J (1 + \tilde{r})^{-j}} - \bar{s}$$

We carry out two thought experiments. We assume that an independent Scotland must reach the Maastricht target debt level of 60% within 10 years. We assume that the existing UK public debt is divided on a per capita basis (see section 3). We follow the Scottish government’s convention of looking at fiscal accounts on the basis of a geographic and population share of hydrocarbons. This matters for two reasons. First, the initial debt burden is substantially lower if calculated as a ratio of GDP including a geographic share of oil: 86% versus 101% of GDP. Second, while it is reasonable to disagree about how quickly output of hydrocarbons will decline, there is clearly a finite amount of reserves. As a result, the growth of GDP including a geographic share of oil will be lower than GDP including a population share of oil. Another way to put this is to achieve the same rate of headline GDP growth requires the non-oil GDP to grow faster.

To pin-down the degree of fiscal adjustment we assume that inflation is 2% in line with the Bank of England’s target and the initial interest rate is 4.8% based on the model estimated above. As the fiscal consolidation is underway the interest rate spread narrows resulting in lower borrowing costs. Although these lower borrowing costs do not reduce the debt service on Scotland’s initial debt levels, they do reduce the rate at which Scotland would be able to borrow in times of stress. Table 3.3 shows the primary fiscal balances necessary to reach the target of a 60% debt ratio.

**Table 4.3 Primary Surpluses to Achieve 60% Debt-GDP Ratio**

| Horizon  | Real GDP Growth Rates |       |       |       |       |       |
|----------|-----------------------|-------|-------|-------|-------|-------|
|          | -2%                   | -1%   | 0     | 1%    | 2%    | 3%    |
| 4 years  | 10.1%                 | 9.3 % | 8.5 % | 7.7 % | 7.0 % | 6.2 % |
| 6 years  | 7.9 %                 | 7.1 % | 6.3 % | 5.6 % | 4.8 % | 4.1 % |
| 8 years  | 6.8 %                 | 6.0 % | 5.3 % | 4.5 % | 3.7 % | 3.0 % |
| 10 years | 6.2 %                 | 5.4 % | 4.6 % | 3.9 % | 3.1 % | 2.4 % |

Assuming that economic growth is a constant 2% per year and the consolidation is over ten years, the average primary fiscal surplus (including oil) must be 3.1% each year. This implies a

<sup>75</sup> A full derivation is presented in Annex 3.

substantial fiscal tightening. Scotland's primary deficit in the fiscal year 2011-12 was 2.3% of GDP when oil tax revenues are divided on a geographic basis implying a fiscal tightening of 5.4% of GDP.<sup>76</sup> According to the OBR, under present UK Government policies the primary deficit will fall to only 0.6% of GDP in 2016-17 from 5.1% of GDP in 2011-12, implying a fiscal tightening of 4.5%. Assuming the percentage point current difference between the UK and the estimated Scottish deficit (based on geographic oil) is constant, a newly independent Scotland would need to engage in an additional 0.9% of fiscal tightening over and above what the UK Government is already proposing.

If instead Scotland only obtained a per capita share of oil and gas, while taking on a per capita share of UK government debt, the required fiscal tightening would be much more onerous. In this case, the required primary surplus to reach the 60% debt target within 10 years would rise to 7.2%.<sup>77</sup> This would imply a fiscal tightening of 17.5%, as Scotland's primary deficit with only a per capita share of oil revenues rises to 10.3% of GDP.<sup>78</sup> The required tightening increases so much due to the increase in borrowing costs to 7.9% induced by the higher initial primary deficit of 10.3%. This underlines the crucial role of the division of both government liabilities and assets for Scotland's initial fiscal position, and by extension for its currency choice.

We emphasize that our results should be seen as lower bounds on the amount of fiscal tightening required to fulfill the 60% debt target. The reason is that fiscal consolidation tends to have a negative impact on real GDP growth, at least in the short run.<sup>79</sup> Assuming a 2.0% rate of real GDP growth against a backdrop of an immediate and permanent fiscal tightening of 5.4% may be optimistic. If instead growth were at a still fairly robust 1.0% annually, then the primary surplus required in the geographic share of oil case would rise to 3.9%, for a total fiscal tightening of 6.2%. Moreover, we assume that the contribution of oil and gas to Scottish GDP would be maintained at its 2000-2012 average level, rather than decreasing as expected by the OBR. In order to achieve a 2% growth rate with a declining oil and gas sector, the non-oil economy would actually have to grow at more than 2% annually. Finally, we are also assuming that the required tightening would be immediate, rather than being spread out over multiple years in relatively small steps. The slower the adjustment to the required surplus, the greater the total amount of tightening required.

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<sup>76</sup> Own calculations based on Scottish Government (2013a).

<sup>77</sup> See the Annex for the full results table.

<sup>78</sup> Own calculations based on Scottish Government (2013a).

<sup>79</sup> Blanchard, Olivier and Daniel Leigh (2013) "Growth Forecast Errors and Fiscal Multipliers," IMF Working Paper WP/13/1.

### **C. Stabilisation with an independent currency**

So far we have looked at the fiscal consolidation in a currency union. However, it would be wrong to assume that if Scotland introduced its own currency fiscal tightening would somehow be irrelevant. In fact, if Scotland were able to irrevocably fix its currency at parity with sterling, the fiscal tightening necessary to reach a given debt target would be exactly the same.

There is another factor that should be considered in assessing the currency options for Scotland, namely the availability of policy options in the event of a shock. A country with its own currency and its own central bank has a number of policy instruments that are not available to a country in a currency union. Countries with high debt burdens tend to have little room to adjust fiscal policy. But having one's own currency creates enables interest rate and exchange rate adjustments and central bank liquidity support. Using the currency of another state can lead to none of the above policies being available. Indeed, once citizens and foreign investors doubt the sustainability of policy and capital flight begins, there can be negative feedback loops until credit risk becomes so high that there are no longer investors in government debt. By contrast, emerging financial imbalances can be mitigated by central bank liquidity support before a crisis arises.

A country should value these additional policy levers more if it is more likely to need them, that is, if it is vulnerable to the consequences of financial imbalances. A country is more vulnerable to financial imbalances if it is highly indebted or has a large financial sector. Scotland is likely to begin life with both characteristics. In the case of high levels of government debt, without having one's own currency a country can quickly find itself without any policy levers and relying on the assistance of other countries. Also, the larger is the financial sector, the greater is the likelihood that a banking crisis would overwhelm public finances, leading to a high government debt level.

This policy flexibility can be a double-edged sword; investors may need convincing that the flexibility will not be used inappropriately and therefore charge slightly more for borrowing funds. Our estimates of an independent Scotland's borrowing costs abstracted from exchange rate risk, as they were based upon a set of countries in a currency union, namely the euro zone. As long as sovereign currencies can never be irrevocably fixed, they carry more exchange rate risk. However, in high debt countries the slight exchange rate risk may prevent a much more expensive credit risk from emerging. High debt countries with their own currency require a credible stabilisation plan can minimise the exchange rate risk while avoiding some of the credit risk because of the presence of a fully functioning central bank.

Another way to reduce the scale of the required stabilization is to sell assets and use the proceeds to pay down the government debt. While selling an asset to repay debt should result in no change in a net asset position, it is the removal of the uncertainty of the income stream and the highly

non-linear nature of credit risk which can be the reward. For Scotland, it might be possible to sell its oil and gas rights in a bid to enter independence with a lower stock of debt, see Box 4.2. At a stroke the debt burden facing an independent Scotland would be greatly reduced (perhaps reduced by one-third). The fiscal deficit would of course be much higher, but without running down natural resources this is a clearer reflection of the amount of adjustment an independent Scotland with a credible fiscal plan must achieve over time. The budgeting difficulties arising from the revenue volatility would also be solved. Since the cost of borrowing is likely to be higher than the targeted returns from an Oil Fund, this also makes more sense for future generations.

#### **Box 4.2 Possible asset sales / debt swap**

Throughout history sovereign states have raised money by selling assets. Assuming that an independent Scotland were awarded a geographic share of North Sea oil and gas reserves, one option would be to sell its rights to the tax receipts for a specific period of time.

If the rights to the tax revenues were sold, it would not be possible to have a gradually accumulating Oil Fund or to use the tax revenues to fund current spending. However, the revenue from the sale could be used to repay the UK for Scotland's share of the UK's government debt. The benefit of an oil and gas for debt swap is that it would reduce Scotland's reliance on this highly volatile source of tax revenue. In section 2, we argued that the volatility of oil and gas tax revenues as a share of Scotland's GDP is substantially larger than the UK's. As a result, volatile oil and gas revenue streams would be much easier for the UK to manage than for an independent Scotland. In other words, the certainty equivalent (taking account of risk) of the tax revenues to an independent Scotland would be less than the certainty equivalent to the UK. It would be in the interests of Scotland to sell the rights to the oil revenue to the UK at a price above its certainty equivalent and for the UK to buy the rights at a price below its certainty equivalent. This would create a mutually beneficial gain.

It is recognised that swapping the tax revenues from oil for debt might be difficult to deliver politically. Selling a major asset does not sit comfortably with the idea of independence. But neither does being heavily indebted. The fiscal challenges of independence means that this may be a price worth paying to start a new Independent Scotland with a low enough debt level to give it room to manoeuvre fiscally.

## 5. CONCLUSION

We argue in this paper that government solvency issues and currency policy choice cannot be considered in isolation. In our view, the Treasury and FCWG analyses place too much emphasis on the marginal gains that currency stability may have on trade flows and not enough on avoiding a financial collapse, which cause a far greater loss of welfare. We conclude that a sound case can be made for an independent Scotland having its own currency because it minimises the risk of such negative outcomes.

An independent Scotland is likely to undergo significant changes to its economic structure. The division of assets and liabilities of the existing UK may result in Scotland having a the dominant share of North Sea Oil and Gas reserves but also a fair share of the very large national debt. How this debt is divided and the funds are transferred is a crucial issue to the credit standing of both nations. Scotland will require a central bank under the EU. At the time of deciding currency policy it is deciding the remit of its new central bank.

If Scotland joins a sterling currency union it forgoes the possibility of providing own liquidity support to the banking sector, to choose monetary policy and an exchange rate policy while fiscal policy will be restricted by the need to reduce its debt burden (and possibly meet UK imposed borrowing criteria). Any agreement to support Scottish financial institutions may rest with the discretion of the UK government. We estimated an interest rate spread that an independent Scotland might face and the size of fiscal adjustment over ten years (based on a set of assumptions). A tougher fiscal consolidation than that being proposed by the current UK government is likely under this scenario. In the event of a significant economic shock there would be little room for policy adjustment.

If an independent Scotland introduced its own currency it would need to implement a similar stabilisation plan to re-assure investors that it intended to significantly reduce its debt burden by repayment rather than devaluation. This would be necessary to minimise the exchange rate risk on the interest rate while reducing the credit risk because of the presence of policy levers which minimises the possibility of a costly debt crisis. Whether the risks are fully offsetting cannot be known. However, the key point is that if an independent Scotland were confronted with a large negative economic shock its flexibility to change policy will prevent a downward spiral of escalating credit risk. These are the events that are so damaging and costly in terms of welfare.

To reduce the amount of debt an independent Scotland would inherit, we propose a debt for oil swap, although this clearly depends on price and politics.

## ANNEX 1: ESTIMATION OF SCOTLAND'S BOND SPREAD

The data sample includes quarterly data from 2000-2012 for all euro zone members, and new members (Slovenia, Slovakia, Cyprus and Malta) from the date that they joined the euro zone. The following panel regression was estimated.<sup>80</sup> The data is from Eurostat.

$$Spread_{i,t} = \beta_0 + \beta_1 \cdot \frac{Debt}{GDP}_{i,t} + \beta_2 \cdot \frac{Deficit}{GDP}_{i,t} + \beta_3 \cdot Liquid_i + \beta_4 \cdot Tax Vol_i + \beta_5 \cdot Bus Cycle_{i,t} + \beta_6 \cdot Crisis_{i,t} + \beta_7 \cdot World_t + \beta_8 \cdot \frac{Debt}{GDP}_{i,t} \cdot Crisis_{i,t} + \beta_9 \cdot \frac{Deficit}{GDP}_{i,t} \cdot Crisis_{i,t}$$

Where:

- $Spread_{i,t}$  the spread between the yield on a 10 year bond of country  $i$  and Germany at date  $t$ ;
- $\frac{Debt}{GDP}_{i,t}$  the difference between country  $i$ 's government debt to GDP relative to Germany at date  $t$ ;
- $\frac{Deficit}{GDP}_{i,t}$  the difference between the government deficit to GDP ratio of country  $i$  and Germany;
- $Tax Vol_i$  measures the volatility of country  $i$ 's tax yield;
- We proxy for the liquidity of country  $i$ 's bond market using its size, measured as population relative to the rest of the Euro zone.

We wish to distinguish between an increase to an already high level of government debt and increases at lower levels of debt. To do this, we decompose  $\frac{Debt}{GDP}_{i,t}$  into two variables:  $\frac{Debt^{PLUS}}{GDP}_{i,t}$  captures the effect of an increase in the Debt-GDP ratio conditional on the Debt-GDP ratio exceeding that of Germany, while  $\frac{Debt^{MINUS}}{GDP}_{i,t}$  captures the impact of an increase in Debt-GDP at lower levels of government debt. We also wish to allow impact of rising deficits to be distinct from that of declining surpluses, and hence perform the analogous decomposition on  $\frac{Deficit}{GDP}_{i,t}$ .

We also include a series of controls:  $Bus Cycle_{i,t}$  measures country  $i$ 's business cycle stance relative to Germany at date  $t$ ,<sup>81</sup> while  $Crisis_{i,t}$  is an indicator variable that takes the value 1 whenever the HP-filtered growth rate is below -5%. The variable  $World_t$  is the spread between a basket of BBB-rated corporate bonds and a US treasury, both with maturity 7-10 years, and is commonly used as a proxy for cyclical global risk appetite<sup>82</sup>. Finally, we allow for interactions between government debt, government deficits and crisis. This allows us to control for a potentially larger impact of a given deficit or debt level during an economic crisis.

<sup>80</sup> The regression run here is similar to that of Bernoth, von Hagen and Schuknecht (2004).

<sup>81</sup> If a country's date  $t$  Hodrick-Prescott detrended growth rate is in excess of 1%, its business cycle indicator takes the value 1. If the HP-filtered growth rate is below -1%, the business cycle indicator takes the value -1. If the growth rate lies between 1% and -1%, the business cycle stance is neutral and the indicator takes the value zero. is obtained as the difference between country  $i$ 's business cycle indicator and Germany's.

<sup>82</sup> See the IMF Global Financial Stability Report, for example.



The *between* coefficient on a country's Deficit-to-GDP ratio captures the average impact of moving from being a country with high average budget deficits to being one with low average government budget deficits. The *within* effect captures the effect of reducing the government budget deficit within a country over time. For the panel variables – Debt-GDP, Deficit-GDP, Current Account-GDP, Business Cycle and Crisis indicators – we can disentangle *between* and *within* effects.<sup>83</sup> We are primarily interested in the cross-sectional *between* effects. Time fixed effects capture periods in which the sovereign spreads of many countries are higher or lower than would otherwise be expected based on the remaining regressors (i.e. the fiscal variables, the business cycle stance). The time fixed effect is significantly positive beginning from 2010:Q1 until the end of the sample 2012:Q4. Including both the crisis dummy variable and the time fixed effects allows us to be confident that our estimates are not contaminated by the abnormally high spreads during the crisis.

### **Baseline Regression Results**

The first column of Table A1.1 shows the model results including a range of interaction terms with the crisis dummy variable, while the second column presents results for an alternative specification with business cycle interaction terms.<sup>84</sup> In both specifications, the key coefficients take the expected signs: higher debt and higher deficit countries face higher borrowing costs as do countries with more volatile tax revenues and which are smaller.

To explain how to translate the results into magnitudes, we use our preferred specification with interactions between fiscal variables and the crisis dummy<sup>85</sup>. A one percentage point increase in the long-run average of government debt as a share of GDP results in an increase in borrowing costs of 1.7 basis point for high-debt countries (defined as average debt above Germany). An increase of one percentage point in the long-run average of government deficit ratio raises borrowing costs of 50.9 basis points.<sup>86</sup> The liquidity effect, which captures some of the additional costs to being a small country, adds 3.5 basis points for every 1 percentage point drop in a country's population share in the Euro zone. An increase of one percentage point in the volatility of tax revenues leads to an increase in the sovereign spread of 6.5 basis points.

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<sup>83</sup> We allowed for distinct between and within coefficients in all regressions, and ran a series of tests for equality of the coefficients. When the test rejected the null of equality of the *between* and *within* effects, we retained separate roles for between and within effects, otherwise not.

<sup>84</sup> The numbers in brackets give p-values.

<sup>85</sup> We choose this as our preferred specification due to its higher  $R^2$ .

<sup>86</sup> The coefficient on Deficit-GDP is relevant for the majority of countries who ran larger government deficits than Germany's on average. Germany's average government deficit was 2.03% of GDP over the sample period.

**Table A1.1: Baseline Sovereign Spread Estimates**

| Variable             |         | Crisis Interactions                             | Business Cycle Interactions                           |
|----------------------|---------|---|---|
| Constant             |         | -2.000<br>(0.000)                               | -1.2687<br>(0.000)                                    |
| Debt-GDP +           | between | 0.017<br>(0.000)                                | 0.015<br>(0.001)                                      |
|                      | within  | 0.064<br>(0.000)                                | 0.114<br>(0.000)                                      |
| Debt-GDP -           | between | 0.002<br>(0.743)                                | 0.007<br>(0.009)                                      |
|                      | within  | 0.037<br>(0.000)                                |   |
| Deficit-GDP          | between | -0.509<br>(0.000)                               | -0.415<br>(0.000)                                     |
|                      | within  | -0.070<br>(0.064)                               | -0.010<br>(0.778)                                     |
| Surplus-GDP          | between | 0.048<br>(0.273)                                | -0.028<br>(0.389)                                     |
|                      | within  | 0.189<br>(0.000)                                | 0.276<br>(0.000)                                      |
| Liquidity            |         | -3.525<br>(0.000)                               | -2.369<br>(0.001)                                     |
| Tax Yield Volatility |         | 6.489<br>(0.050)                                | 12.629<br>(0.000)                                     |
| World (BBB-Spread)   |         | 0.229<br>(0.000)                                | 0.186<br>(0.001)                                      |
| Crisis               |         | 3.314<br>(0.357)                                | 3.330<br>(0.000)                                      |
| Boom                 |         | 0.406<br>(0.004)                                | 0.374<br>(0.036)                                      |
| N                    |         | 603   | 603   |
|                      |         | 0.829   | 0.795   |
| Time Fixed Effects   |         | Yes   | Yes   |
| Further Controls     |         | Business Cycle<br>Crisis*Debt<br>Crisis*Deficit | Business Cycle<br>Bus Cycle*Debt<br>Bus Cycle*Deficit |

**Alternative Specification**

For robustness, we also ran a second set of regressions which include the current account balance with the rest of the world as a percentage of GDP as a regressor. Results of these regressions are shown in Table A1.2. The implied spreads for an independent Scotland vs. Germany turn out to be somewhat smaller under this method, at about 1.4%. Added to Germany's long-run average 10-year borrowing costs of 3.6%, this would imply borrowing costs for Scotland of about 5.0%. The main reason that this specification is not the baseline case is that we have no good proxy for Scotland's current

account balance with the rest of the world, and hence would not be able to make use of this variable when computing the sovereign yield spread over the UK or Germany.

**Table A1.2: Alternative Sovereign Spread Estimates**

**Current Account Balances as Regressors**

| Variable             |         | Crisis Interactions   | Business Cycle Interactions |
|----------------------|---------|---|-----------------------------|
| Constant             |         | -2.138<br>(0.000)   | -2.078<br>(0.000)           |
| Debt-GDP +           | between | 0.010<br>(0.000)  | 0.010<br>(0.001)            |
|                      | within  | 0.069<br>(0.000)  | 0.072<br>(0.000)            |
| Debt-GDP -           | between | -0.008<br>(0.062)   | -0.009<br>(0.025)           |
|                      | within  | 0.043<br>(0.000)  | 0.042<br>(0.000)            |
| Deficit-GDP          | between | -0.187<br>(0.000)   | -0.167<br>(0.000)           |
|                      | within  | -0.043<br>(0.309)   | -0.029<br>(0.389)           |
| Surplus-GDP          | between | -0.092<br>(0.010)   | -0.091<br>(0.008)           |
|                      | within  | 0.135<br>(0.000)  | 0.130<br>(0.000)            |
| Curr Acct-GDP        | between | -0.063<br>(0.007)   | -0.068<br>(0.002)           |
|                      | within  | 0.058<br>(0.000)  | 0.054<br>(0.001)            |
| Liquidity            |         | -2.626<br>(0.001)   | -2.562<br>(0.001)           |
| Tax Yield Volatility |         | -0.733<br>(0.880)   | -1.626<br>(0.737)           |
| World (BBB-Spread)   |         | 0.318<br>(0.000)  | 0.312<br>(0.000)            |
| Crisis               |         | 0.002<br>(0.997)  | 0.523<br>(0.050)            |
| Boom                 |         | 0.314<br>(0.005)  | 0.290<br>(0.007)            |
| N                    |         | 524   | 524                         |
|                      |         | 0.796   | 0.799                       |
| Time Fixed Effects   |         | Yes   | Yes                         |
| Further Controls     |         | Business Cycle<br>Crisis*Debt<br>Crisis*Deficit<br>Crisis*Curr Acct | Business Cycle              |

## ANNEX 2: PRIMARY SURPLUSES FOR ALTERNATIVE GROWTH RATES AND HORIZONS

**Table A2.1 Primary Surpluses to Achieve 60% Debt-GDP Ratio, per capita share of oil and gas**

|          | Real GDP Growth Rates |        |        |        |        |        |
|----------|-----------------------|--------|--------|--------|--------|--------|
| Horizon  | -2%                   | -1%    | 0      | 1%     | 2%     | 3%     |
| 4 years  | 17.1 %                | 16.1 % | 15.2 % | 14.3 % | 13.4 % | 12.5 % |
| 6 years  | 13.6 %                | 12.6 % | 11.7 % | 10.8 % | 9.9 %  | 9.1 %  |
| 8 years  | 11.8 %                | 10.9 % | 10.0 % | 9.1 %  | 8.2 %  | 7.4 %  |
| 10 years | 10.8 %                | 9.9 %  | 9.0 %  | 8.1 %  | 7.2 %  | 6.3 %  |

**Table A2.2 Primary Surpluses to Achieve 60% Debt-GDP Ratio, Oil-Debt Swap**

|          | Real GDP Growth Rates |       |       |       |       |       |
|----------|-----------------------|-------|-------|-------|-------|-------|
| Horizon  | -2%                   | -1%   | 0     | 1%    | 2%    | 3%    |
| 4 years  | 3.1 %                 | 2.5 % | 1.9 % | 1.3 % | 0.7 % | 0.2 % |
| 6 years  | 3.5 %                 | 2.9 % | 2.3 % | 1.7 % | 1.1 % | 0.6 % |
| 8 years  | 3.7 %                 | 3.1 % | 2.5 % | 1.9 % | 1.3 % | 0.8 % |
| 10 years | 3.9 %                 | 3.2 % | 2.6 % | 2.0 % | 1.4 % | 0.9 % |

## ANNEX 3: DERIVATIONS

### A3.1 Solvency conditions (2) and (3)

First, assume that the interest rate  $r_t = r$  is constant over time and solve the debt evolution equation

(1) for the initial debt level  $D_{t-1}$  to obtain:

$$D_t = \frac{1}{1+r} (D_{t+1} + X_{t+1} + S_{t+1})$$

Take this equation one step ahead

$$D_{t+1} = \frac{1}{1+r} (D_{t+2} + X_{t+2} + S_{t+2})$$

And substitute forward to obtain

$$D_t = \frac{1}{(1+r)^2} D_{t+2} + \frac{1}{(1+r)^2} (X_{t+2} + S_{t+2}) + \frac{1}{(1+r)} (X_{t+1} + S_{t+1})$$

Substituting forward repeatedly yields

$$D_t = \frac{1}{(1+r)^j} D_{t+j} + \sum_{i=1}^j \frac{1}{(1+r)^i} (X_{t+i} + S_{t+i})$$

Taking the limit as  $j \rightarrow \infty$  yields:

$$D_t = \lim_{j \rightarrow \infty} \frac{1}{(1+r)^j} D_{t+j} + \sum_{i=1}^{\infty} \frac{1}{(1+r)^i} (X_{t+i} + S_{t+i})$$

As long as  $r > 0$  - so that  $\lim_{j \rightarrow \infty} \frac{1}{(1+r)^j} = 0$  - and  $D_{t+j}$  is a finite amount of debt at date  $t + j$ ,

then the transversality or no Ponzi scheme condition holds:

$$\lim_{j \rightarrow \infty} \frac{1}{(1+r)^j} D_{t+j} = 0$$

The transversality condition states that debt must be paid off in finite time. If the transversality condition did not hold, then the debt would be growing at a faster rate than the discount factor is shrinking towards zero, and (some portion of) current debt would not ever be paid off.

As long as the transversality condition holds, then the level of current debt  $D_t$  can be described as the discounted sum of all future primary fiscal surpluses and seigniorage revenues:

$$D_t = \sum_{i=1}^{\infty} \frac{1}{(1+r)^i} (X_{t+i} + S_{t+i})$$

### A3.2: Fiscal Consolidation Condition (5)

Begin with equation (4), the per capita version of the govt debt equation and solve it for initial debt  $d_t$  to obtain

$$d_t = \frac{(1 + \pi)(1 + g)}{(1 + r)} (d_{t+1} + x_{t+1} + s_{t+1})$$

Take the equation one step ahead to obtain

$$d_{t+1} = \frac{(1 + \pi)(1 + g)}{(1 + r)} (d_{t+2} + x_{t+2} + s_{t+2})$$

Substituting forward to a horizon of  $t + J$  yields:

$$d_t = \frac{(1 + \pi)^J (1 + g)^J}{(1 + r)^J} d_{t+J} + \sum_{j=1}^J \frac{(1 + \pi)^j (1 + g)^j}{(1 + r)^j} (x_{t+j} + s_{t+j})$$

We are looking to pin down the constant primary surplus  $\bar{x}$  that would allow a country with an initial debt level of  $d_t$  to reach a targeted debt level of  $d_{t+J}$  by period  $t + J$ . To that end, we assume that primary surpluses and seigniorage levels are constant over time, and rearrange to solve for the constant primary surplus  $\bar{x}$ :

$$\bar{x} = \frac{1}{\sum_{j=1}^J \frac{(1 + \pi)^j (1 + g)^j}{(1 + r)^j}} d_t - \frac{\frac{(1 + \pi)^J (1 + g)^J}{(1 + r)^J}}{\sum_{j=1}^J \frac{(1 + \pi)^j (1 + g)^j}{(1 + r)^j}} d_{t+J} - \bar{s}$$

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