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ABSTRACT

We explore the consequences of safe asset scarcity on aggregate demand in a stylized IS-LM/Mundell Fleming environment. Acute safe asset scarcity forces the economy into a “safety trap” recession. In the open economy, safe asset scarcity spreads from one country to the other via capital flows, equalizing interest rates. Acute global safe asset scarcity forces the economy into a global safety trap. The exchange rate becomes indeterminate but plays a crucial role in both the distribution and the magnitude of output adjustment across countries. Policies that increase the net supply of safe assets somewhere are output enhancing everywhere.

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The chronic scarcity of safe assets has been linked to a large list of macroeconomic illnesses. These range from Greenspan's conundrum and the global imbalances of the mid 2000s, to the now endemic negative natural rates in most developed economies. In Caballero and Farhi (2014) and Caballero, Farhi and Gourinchas (2015) we provide detailed models of the closed and open economy implications, respectively, of this scarcity. In this short paper we present a highly stylized model, IS-LM/Mundell-Fleming style, that captures some of the central mechanisms and implications described in those papers.

In a nutshell, in our model the safe-asset market equilibrium supplements the IS relationship and the Taylor Rule, to endogenously determine output, the interest rate, and the risk premium. A drop in the supply of safe assets reduces output and increases the risk premium. The central bank can offset the output reduction by lowering interest rates within a range. When the scarcity of safe asset is acute, the Zero Lower Bound (ZLB) becomes binding and the safe asset market equilibrates via a reduction in output, akin to a liquidity trap, which we call a *safety trap* to emphasize its origins in the safe asset market.

In the open economy, the scarcity of safe assets spreads from one country to the other via the capital account. Net safe asset producers export these assets to net safe asset absorbers until interest rates are equalized across countries. As the global scarcity of safe assets intensifies, interest rates drop and capital flows increase to restore equilibrium in global and local safe asset markets. Once the ZLB is reached, output becomes the adjustment variable again. The world economy enters a regime of increased interdependence as countries cannot use monetary policy to insulate their economies from world capital flows.

The exchange rate becomes indeterminate, but plays a crucial role in both the distribution and the magnitude of the adjustment. Devaluations are *beggar-thy-neighbor*. If the currency of the net safe asset producer country appreciates, it reduces the global scarcity of safe assets via valuation effects. However, this comes at a significant output cost for the safe asset producing country. Policies that increase the net supply of safe assets somewhere are output enhancing everywhere. In contrast, policies that remove safe assets from the private

sector to encourage risk-taking do the opposite.

1 Closed economy

Denote y output, r the *risky* expected real rate of return and r^s the *safe* real rate of return. The economy is stationary and prices are permanently fixed so nominal and real rates of return coincide. The standard IS-LM model considers the markets for goods and money (which implies that the market for perfectly substitutable bonds and loans clears by Walras' Law). We assume instead that safe and risky assets are not perfect substitutes, and consider three markets: goods, money (or equivalently a Taylor rule) and safe assets, with the market for risky assets clearing by Walras' Law. We place ourselves in the cashless limit and therefore ignore the money market, except for the fact that it imposes a ZLB constraint. The economy is characterized by the following system:

$$y - \bar{y} = -\delta(r - \bar{r}) - \delta_s(r^s - \bar{r}^s) \quad (\text{IS})$$

$$r^s = \max(\hat{r}^s + \phi(y - \bar{y}), 0) \quad (\text{TR})$$

$$s = \psi_y y + \psi_s r^s - \psi_\Delta(r - r^s) \quad (\text{SA})$$

Equation (IS) characterizes the goods market equilibrium. \bar{y} , \bar{r} and \bar{r}^s denote *potential* output and the *natural* risky and safe expected returns. We envision a situation where δ_s is small as the private sector has limited capacity to issue safe debt to fund its projects. Equation (TR) is a Taylor-rule type relationship: monetary authorities set the nominal *riskless* interest rate in response to the output gap, where \hat{r}^s is the target nominal interest rate. The monetary authority faces a ZLB: the safe interest rate cannot turn negative.

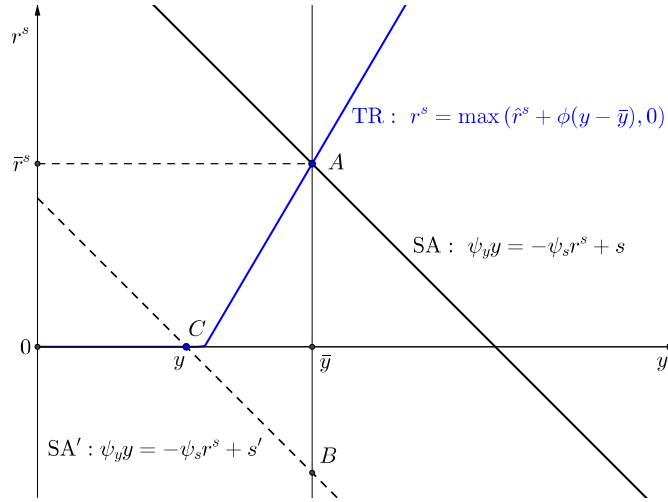
Equation (SA) is new. It represents equilibrium in the market for safe assets. s denotes the supply of safe assets, considered exogenous here, and the right hand side denotes the demand for safe assets. Both are *gross*, since safe assets are in zero *net* supply, issued

by safe asset suppliers to safe asset absorbers (there are no physical safe assets). A stock interpretation of equation (SA) is possible if safe asset absorbers allocate their wealth between money and safe assets, and the demand for the latter depends on the spread between safe assets and money r^s , the spread between risky and safe assets $r - r^s$, and the liquidity services of safe assets which increase with output y . Our preferred interpretation is in terms of flows, rather than stocks: s is the *net increase* in the supply of safe assets, equal to the net increase in demand over a given period. This is the relevant interpretation since safe asset markets have a large share of ‘buy-and-hold’ private and public institutional investors driven in part by mandates and regulation. As a result, a large part of safe asset positions are essentially idle at high frequencies. In this context, demand increases with income y and with the return on safe assets r^s (capturing rigid income allocation and reinvestment into safe assets), and decreases with the risk premium $r - r^s$ (capturing search for yield considerations).

The usual IS-LM analysis obtains in the limit case $\psi_\Delta \rightarrow \infty$, where the risk premium disappears. We are interested in the opposite extreme, $\psi_\Delta = 0$, where safe assets markets are unresponsive to the risk premium. Going forward, we impose $\psi_\Delta = 0$. This specification of equation (SA) arises naturally in models with heterogeneity in risk preferences where a key driver of safe asset demand is the change in wealth of safe asset absorbers (which increases with y and r^s) and where the supply of safe asset is unresponsive to current conditions because of various constraints on securitization (see e.g. Gennaioli, Shleifer and Vishny (2012), Barro and Mollerus (2014), Caballero and Farhi (2014), and Caballero et al. (2015)).

Away from the ZLB. With $\psi_\Delta = 0$, the system IS-TR-SA becomes recursive, with the last two equations determining the safe interest rate and equilibrium output, while the IS equation pins down the risk premium given these. Equilibrium outside the ZLB is represented in Figure 1, which illustrates the determination of output y and the safe interest rate r^s from TR and SA.

Reductions in the target nominal interest rate \hat{r}^s shift the TR curve to the right, and result in a decrease in the safe interest rate r^s , an increase in output y , and under reasonable



Note: Outside the ZLB, output is at potential (\bar{y}) and monetary policy targets the natural safe rate (\bar{r}^s) [Point A]. If the natural safe rate is negative [Point B] because of excess safe asset demand, the economy is at the ZLB and output must fall [Point C].

Figure 1: TR-SA diagram for a closed economy

parameter conditions (δ_s small enough) a decrease in the risky expected return r . Similarly, reductions in the supply of safe assets s shift the SA curve to the left and result in a decrease in the safe interest rate r^s , a reduction in output y , and an increase in the risky expected return r .

SA determines the *natural* interest rate consistent with equilibrium in the safe asset market when output is at potential: $\bar{r}^s = (s - \psi_y \bar{y}) / \psi_s$. Inspecting the system, the monetary authorities can achieve potential output, $y = \bar{y}$, by choosing a target rate equal to the natural interest rate, $\hat{r}^s = \bar{r}^s$, as long as $\bar{r}^s \geq 0$. The risky expected rate of return is then at its natural value $r = \bar{r}$.

At the ZLB: the safety trap. Suppose now that the supply of safe assets is low enough compared to potential output ($s < \psi_y \bar{y}$) so that the natural interest rate is negative $\bar{r}^s < 0$.

The monetary authorities must set $r^s = 0$ and output is pinned down by the SA condition: $y = s / \psi_y < \bar{y}$. The risky expected return r follows from the IS condition:

$$r = \bar{r} + (\bar{y} - y) (\psi_s - \delta_s \psi_y) (\delta \psi_s) > \bar{r}.$$

That is, the risky expected rate of return r and the risk premium $r - r^s$ endogenously increase with the depth of the recession. The economy enters a ‘*safety trap*’ recession: equilibrium in the safe asset market is restored through a decline in output rather than through a more benign reduction in interest rates.

2 Open Economy

Let’s now consider an economy with two countries, Home and Foreign. We write the home IS curve describing equilibrium in the goods market as:

$$y - \bar{y} = -\delta (r - \bar{r}^a) - \delta_s (r^s - \bar{r}^{s,a}) - \eta_y (y - \bar{y}) + \eta_{y^*} (y^* - \bar{y}^*) - \eta_e (e - \bar{e}^a).$$

The first two terms are as before and can be interpreted as domestic absorption. \bar{r}^a and $\bar{r}^{s,a}$ are the home natural risky and safe expected rates of return of the economy under financial autarky. The last three terms reflect the trade balance components of domestic aggregate demand. e is the nominal exchange rate (equal to the real exchange rate since prices are constant), with the convention that an increase in e is an appreciation of the home currency. We assume the trade balance worsens with domestic output and the nominal exchange rate e , and improves with foreign output y^* where stars denote foreign variables. Finally, \bar{e}^a is the natural autarky exchange rate such that trade is balanced when home and foreign output are at potential ($y = \bar{y}$ and $y^* = \bar{y}^*$). A similar IS condition holds for the foreign country. We assume the two countries share the same coefficients $\delta^* = \delta$, $\delta_s^* = \delta_s$, $\psi_y^* = \psi_y$ and $\psi_s^* = \psi_s$. Crucially, we allow for differences in natural variables \bar{r}^{a*} , $\bar{r}^{s,a*}$, and \bar{y}^* .

2.1 Financial Autarky

Under financial autarky, the markets for safe assets clear separately in each country. Full employment can be achieved by setting target interest rates \hat{r}^s and \hat{r}^{s*} equal to the autarky natural safe interest rate $\bar{r}^{s,a}$ and $\bar{r}^{s,a*}$, as long as the latter are positive. The risky expected

returns and the exchange rate are then at their natural levels $r = \bar{r}^a$, $r^* = \bar{r}^{a*}$, and $e = \bar{e}^a$.

If one or both natural safe rates are negative, one or both countries experiences a safety trap with $r^{s,a,i} = 0$ in country i and output determined from the SA condition as: $y^{a,i} = s^i/\psi_y < \bar{y}^i$. The risky rate in country i can be expressed as: $r^{a,i} = \bar{r}^{a,i} + (\bar{y}^i - y^{a,i})(\psi_s - \delta_s\psi_y)/(\delta\psi_s) > \bar{r}^{a,i}$, and the risk premium increases with the depth of the home recession. Finally, the exchange rate e^a is such that trade is balanced: $-\eta_y(y^a - \bar{y}) + \eta_{y^*}(y^{a*} - \bar{y}^*) - \eta_e(e^a - \bar{e}^a) = 0$. The autarky exchange rate is more appreciated (depreciated) the more depressed is home (foreign) autarky output.

2.2 Financial Integration

Suppose now that financial markets are integrated and that home and foreign risky assets are perfect substitute, as are home and foreign safe assets. In steady state the exchange rate is constant so the return on risky and safe assets is equated across countries: $r = r^*$ and $r^s = r^{s*}$.

Away from the ZLB. Consider first the case where each country can achieve its potential output. For a given exchange rate e , the global safe asset market clearing condition takes the form:

$$se + s^* = e(\psi_y\bar{y} + \psi_s\bar{r}^s) + (\psi_y\bar{y}^* + \psi_s\bar{r}^{s*}).$$

It follows that \bar{r}^s is an exchange rate-weighted average of the natural autarky safe returns, $\bar{r}^{s,a}$ and $\bar{r}^{s,a*}$: $\bar{r}^s(e) = \bar{r}^{s,a}e/(e+1) + \bar{r}^{s,a^*}/(e+1)$, where $\bar{r}^s(e)$ increases with e when Home is relatively abundant in safe assets, i.e. $\bar{r}^{s,a} > \bar{r}^{s,a^*}$. This is intuitive: If Home is relatively abundant in safe assets, an appreciation of the home currency increases their net supply, pushing up the global safe yield. In that case, in the integrated equilibrium Home must be a net exporter of safe assets, i.e.:

$$s - \psi_y\bar{y} - \psi_s\bar{r}^s(e) > 0 > s^* - \psi_y\bar{y}^* - \psi_s\bar{r}^{s*}(e).$$

Substituting $\bar{r}^s(e)$ into the Home and Foreign goods market condition and imposing that global trade is balanced, we can solve for \bar{r} and \bar{e} :

$$\bar{r} = \frac{\bar{e}}{\bar{e} + 1} \bar{r}^a + \frac{1}{\bar{e} + 1} \bar{r}^{a*} \quad ; \quad \eta_e (\bar{e} - \bar{e}^a) = \frac{\delta (\bar{r}^a - \bar{r}^{a*}) + \delta_s (\bar{r}^{s,a} - \bar{r}^{s,a*})}{\bar{e} + 1}$$

Like the equilibrium safe return, the equilibrium risky return is the exchange rate-weighted average of the natural autarky risky returns. The exchange rate depends on Home's relative abundance in risky assets ($\bar{r}^a - \bar{r}^{a*}$) and in safe assets ($\bar{r}^{s,a} - \bar{r}^{s,a*}$). If Home is sufficiently abundant in at least one of the two assets, then the exchange rate must appreciate in the integrated equilibrium, $\bar{e} > \bar{e}^a$, and Home must run a trade deficit. This is intuitive: If Home is sufficiently abundant in at least one of the two assets, it attracts *net* capital inflows, and its currency appreciates under integration.

Gross and net flows differ: a country could export safe assets ($\bar{r}^{s,a} > \bar{r}^{s,a*}$) while running a trade surplus if $\delta (\bar{r}^a - \bar{r}^{a*}) + \delta_s (\bar{r}^{s,a} - \bar{r}^{s,a*}) < 0$, which could capture the situation of countries such as Switzerland or Germany nowadays.

Outside the ZLB, a decrease in the global supply of safe assets decreases the equilibrium return on safe assets \bar{r}^s (for δ_s small enough). The currency of the country whose safe asset supply decreases depreciates. Via valuation effects, this mitigates the initial decline in safe asset supply and helps restore equilibrium on the global market for these assets. The global risk premium $\bar{r} - \bar{r}^s$ increases and output remains unchanged.

At the ZLB: the global safety trap. Consider now what happens when the natural risk free rate $\bar{r}^s(\bar{e})$ falls below 0. The ZLB constraint requires $r^s = 0$ and the equilibrium conditions become:

$$\begin{aligned} (1 + \eta_y)(y - \bar{y}) &= -\delta (r - \bar{r}^a) + \delta_s \bar{r}^{s,a} + \eta_{y^*} (y^* - \bar{y}^*) - \eta_e (e - \bar{e}^a), \\ (1 + \eta_{y^*}^*)(y^* - \bar{y}^*) &= -\delta (r - \bar{r}^{a*}) + \delta_s \bar{r}^{s,a*} + \eta_y^* (y - \bar{y}) + \eta_e^* (e - \bar{e}^a), \\ e s + s^* &= \psi_y (e y + y^*). \end{aligned}$$

This is a system of three equations in four unknowns (y, y^*, r, e) , so there is a fundamental indeterminacy. In the global safety trap, total output needs to fall to equilibrate the market for safe assets, but it is indeterminate how much of this fall should occur at home or in foreign. The exchange rate pins down the distribution of output reductions, with a more depreciated exchange rate associated with a smaller output reduction at Home and a larger one in Foreign.

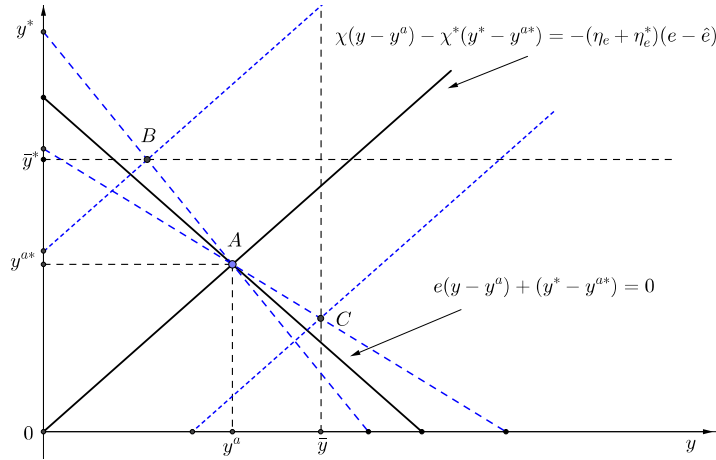
We can index these equilibria by the value of the exchange rate. To fix ideas, consider the case where both $\bar{r}^{s,a} < 0$ and $\bar{r}^{s,a^*} < 0$ so that each country is in a safety trap under financial autarky. We can rewrite the equilibrium conditions in deviation from autarky:

$$e (y - y^a) + (y^* - y^{a^*}) = 0 \quad (1)$$

$$(y - y^a) (1 + \eta_y + \eta_y^*) - (y^* - y^{a^*}) (1 + \eta_{y^*} + \eta_{y^*}^*) = \delta (r^a - r^{a^*}) - (\eta_e + \eta_e^*) (e - e^a) \quad (2)$$

Equation (1) says that home output can increase above its autarky level ($y > y^a$) only if foreign output decreases below it ($y^* < y^{a^*}$). Equations (1)-(2) together imply that home (foreign) output decreases below (increases above) autarky when the exchange rate e exceeds \hat{e} such that: $(\eta_e + \eta_e^*)(\hat{e} - e^a) = \delta(r^a - r^{a^*})$. Figure 2 illustrates graphically the role of the exchange rate and the potential for currency wars. At point A, $e = \hat{e}$ and the global economy achieves the autarky levels of output $y = y^a$ and $y^* = y^{a^*}$. As the exchange rate depreciates below \hat{e} , schedule (1) rotates counterclockwise while schedule (2) shifts right: home output increases, foreign output decreases and home's trade balance improves. For a sufficiently depreciated exchange rate, Home achieves potential output (point C) at which point it escapes the safety trap at the expense of the foreign country.

While outside the ZLB (in the limit $\delta_s \approx 0$) the scarcity of safe assets did not affect output, the exchange rate, or the trade balance, at the ZLB this is no longer true and the scarcity of safe assets depresses output globally, with the distribution of output reductions, and therefore trade balances, pinned down by the exchange rate.



Note: When $e = \hat{e}$, each country achieves its autarky output (y^a, y^{a*}) [point A]. When $e < \hat{e}$ ($e > \hat{e}$), home output increases (decreases) and foreign output increases (decreases). If the exchange rate is sufficiently depreciated (appreciated), Home (Foreign) escapes the safety trap (point C and point B respectively). $\chi = 1 + \eta_y + \eta_y^*$ and $\chi^* = 1 + \eta_{y^*} + \eta_{y^*}^*$.

Figure 2: Currency Wars in the Global Safety Trap

3 Some Policy Remarks

In the safety trap world, any policy that expands safe asset supply anywhere has expansionary effects everywhere and reduces risk premia. Public debt issuance is expansionary, to the extent that it is safe, and that future taxation does not curtail the private sector's ability to issue safe assets. The early QE programs swapping risky for safe assets belong to this category. So do policies that boost private securitization capacity (bank recapitalizations, support to securitization markets in the form of purchases of securitized products, etc.). Operation twist type policies that swap super safe (negative beta) long term government bonds for safe (zero beta) short term government bonds or reserves do not, because they reduce the global supply of safe assets (see Caballero and Farhi (2014)).

Fiscal stimulus anywhere (increases in government spending enter as positive aggregate demand shifters in the IS curves) also stimulates output everywhere, but via its impact on safe assets rather than through the standard IS shift in the IS-LM model. When fiscal stimulus is financed by taxes that do not reduce pledgeable income and hence the private supply of safe assets, global output increases because of a reduction in safe asset demand at

any given level of output (increases in taxes reduce disposable income and act as negative safe asset demand shifters in the global SA curve). When fiscal stimulus is (safe) debt financed instead, global output increases because it corresponds to an increase in safe asset supply at any given level of output as above. In both cases, there are opposing effects on risk premia from the increase in government spending net of taxes (which increases risk premia) and from the increase in global output (which lowers risk premia).

Exchange rate policies and capital account policies have negative spillovers and increase risk premia. The exchange rate is indeterminate, but a big player (such as a central bank) can still in principle set the exchange rate at any desired level, thereby pinning down the equilibrium, by standing ready to exchange home for foreign currency at the target level in unlimited amounts. In this context, devaluations are *beggar-thy-neighbor*, increasing output in the devaluing country and reducing it abroad. Similarly a net safe asset producer can be tempted to impose taxes on safe capital inflows, or even to close its capital account, in order to insulate its economy from the contractionary consequences of safe asset scarcity.

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