Monetary Union and Financial Integration

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Abstract

Since the creation of the euro, capital flows among member countries have been large and volatile. Motivated by this fact, I provide a theory connecting the exchange rate regime to financial integration. The key feature of the model is that monetary policy affects the value of collateral that creditors seize upon default. Under flexible exchange rates, national governments can expropriate foreign creditors by depreciating the exchange rate, which induces investors to impose tight constraints on international borrowing. Creating a monetary union, by eliminating this source of currency risk, increases financial integration among member countries. This process, however, does not necessarily lead to higher welfare. The reason is that a high degree of capital mobility can generate multiple equilibria, with bad equilibria characterized by inefficient capital flights. Capital controls or fiscal transfers can eliminate bad equilibria, but their implementation requires international cooperation.

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1 Introduction

What are the benefits and costs from adopting a common currency? This question has been at the centre of a long-standing debate in international macroeconomics. Friedman (1953) famously claimed that flexible exchange rates act as shock absorbers, so that fixing exchange rates generates welfare losses by increasing macroeconomic volatility. Ingram (1973), instead, provided a more positive view of currency unions. He argued that forming a currency union fosters financial integration among member countries, leading to a more efficient international allocation of capital and higher welfare.

Ingram's view resonates well with some aspects of the euro area experience. Indeed, the introduction of the euro has been accompanied by a sharp increase in financial flows among member countries (Lane, 2006). Moreover, existing empirical evidence suggests that the elimination of currency risk is the main driver behind the euro's positive impact on financial integration (Kalemli-Ozcan et al., 2010). But some crucial questions are open. First, why should the exchange rate regime matter for financial integration and capital flows? And does higher financial integration necessarily lead to higher welfare, especially in light of the fact that several euro area countries suffered crisis periods characterized by financial instability and capital flights (Lane, 2012; Shambaugh, 2012)?

In this paper, I tackle these questions by developing a simple framework connecting monetary policy and international capital flows. There are three frictions at the heart of the model. The first one is the presence of nominal wage rigidities, a classic friction in monetary economics, which implies that monetary policy has real effects on output. The second friction, typical of the macro-finance literature, is that output is used as collateral to perform financial transactions. The combination of these two frictions creates a link between monetary policy and financial flows. By affecting output, indeed, monetary policy also influences the value of collateral and potentially capital flows.[1] The third friction is that monetary authorities lack the ability to commit.

The first result of the paper is that, in accordance with Ingram's view, forming a currency union increases financial integration among member countries. The reason is simple. In the model, an exchange rate depreciation reduces the value of the collateral that foreign investors repossess when domestic agents default. National governments thus face a time-consistency problem. Once the external debt of a country exceeds a threshold, it is optimal for the government to engineer a depreciation to expropriate foreign creditors. Anticipating this behavior, international investors escape expropriation by imposing tight constraints on international borrowing.[2] Consequently,

[1] The main results of the paper apply as long as monetary policy can influence the payment received by foreign investors from domestic agents. For instance, collateral often takes the form of some long-lived asset, such as capital, land or housing. If monetary policy affects the foreign currency value of this asset, as for example in Fornaro (2015), the main results of the paper hold.

[2] It is often claimed that investors can escape currency risk by denominating debt contracts in a foreign currency. This is not the case here, since expropriation occurs because the exchange rate affects the value of collateral backing financial contracts. In fact, in the model foreign investors face currency risk even though I assume, consistent with the empirical evidence provided by Maggiori et al. (2019), that they do not accept to sign debt contracts denominated in domestic currency.

under flexible exchange rates international financial integration is limited.

In a monetary union national governments delegate monetary policy to a supranational authority, the union's central bank. Joining a currency union thus imposes a *vincolo esterno* - that is an external constraint - on national governments, preventing them from using monetary policy to expropriate foreign creditors.[3] As a result, in a currency union countries can sustain a higher stock of foreign debt without defaulting. Creating a monetary union therefore relaxes international borrowing constraints and increases financial integration among member countries.

Does this process lead to efficient capital flows and higher welfare? I first show that adopting a common currency might increase welfare by fostering capital flows toward high-productivity countries.[4] For this to happen, two conditions have to be met. First, there must be some asymmetry in terms of investment opportunities among the member countries of the union. This result contrasts with the traditional optimal currency area literature, in which giving up exchange rate flexibility is costly precisely when countries are asymmetric (Mundell, 1961). Second, financial frictions need to be severe enough to prevent an efficient international allocation of capital under flexible exchange rates. Hence, it is optimal to form a currency union only if financial markets are not too developed to start with.

But this benign view does not square well with the recent experience of the euro area, characterized by financial instability and volatile capital flows. As argued by a vast literature, financial instability might be the result of complementarities in investment decisions (Akerlof, 2019). Building on this insight, I introduce investment complementarities by considering an economy in which governments finance some fixed expenditure with taxes on capital income. This opens the door to fluctuations in capital flows purely driven by animal spirits.[5] Expectations of high taxes on capital, the logic is, can trigger a capital flight and a fall in domestic investment. The associated fall in the tax base forces the government to raise taxes, inducing another round of capital flights. This feedback loop can make pessimistic expectations self-fulfilling, and give rise to capital flights out of high-productivity countries.

Importantly, episodes of inefficient capital flights can take place only if financial integration is sufficiently high. Therefore monetary unions, with their inherent high degree of capital mobility, are particularly prone to experience expectations-driven fluctuations in capital flows. Forming a monetary union might thus lower welfare, by inducing volatility in international financial flows and capital misallocation. Furthermore, inefficient capital flights are more likely to happen when

[3]The expression *vincolo esterno* - meaning external constraint in Italian - was introduced by Italian policymakers during the negotiations leading to the Maastricht treaty (Dyson and Featherstone, 1999). Back then, it was a widespread belief among Italian policymakers that the euro would carry a desirable external constraint on domestic policy.

[4]Empirically, the welfare gains from improving the allocation of capital across countries seem not to be large, especially if compared to differences in productivity (Gourinchas and Jeanne, 2006). However, capital inflows can also benefit productivity. For instance, inflows of foreign capital could help finance innovation activities and thus productivity growth. Or, as in Gourinchas and Jeanne (2005), capital inflows could induce the government to implement productivity-enhancing reforms.

[5]The reason is that the presence of taxes on capital gives rise to private increasing returns to investment. In fact, the main results of the paper would go through as long as the private return to investment is increasing in aggregate investment. For instance, in Appendix *B* I study a version of the model in which investment complementarities arise from the presence of technological spillovers across firms.

a monetary union is hit by large shocks requiring a fiscal response, such as during the ongoing Covid-19 pandemic. In this respect, the model suggests that participating in a common currency might hamper national governments' ability to react to shocks through fiscal policy, due to high capital mobility and the risk of capital flights driven by pessimistic animal spirits.

A natural question to ask is what policy interventions can prevent self-fulfilling capital flights from taking place. One possibility is to impose controls on capital flows. Another option is to set up a system of countercyclical fiscal transfers among the countries of the union, in the spirit of Kenen (1969) and Farhi et al. (2014). If credible, the presence of a countercyclical transfers scheme anchors agents' expectations on the good equilibrium, in which capital flows toward high-productivity countries. Volatility in capital flows driven by animal spirits is thus ruled out, without the need to actually transfer resources among countries in equilibrium.

While these policies are beneficial from a global perspective, however, they might lower welfare for some countries in the union. Intuitively, during an episode of inefficient capital flights, receiving countries benefit from inflows of cheap foreign capital. Implementing policies that rule out capital flights driven by pessimistic expectations might then lower welfare in safe-haven countries. Successfully managing financial integration in a monetary union is therefore possible, but it requires close international cooperation.

Related literature. This paper contributes to the optimal currency area literature, which studies the costs and benefits associated with forming a monetary union. Friedman (1953) argues that joining a monetary union is costly, because the loss of independent monetary policy leads to higher output volatility in response to asymmetric shocks. Benigno (2004) provides a modern formulation of this argument using a New Keynesian open-economy model. A large literature has considered factors that mitigate the impact on welfare of asymmetric shocks in monetary unions. To cite a few examples, Mundell (1961) and Farhi and Werning (2014) stress the role of labor mobility, Kenen (1969), Gali and Monacelli (2008) and Farhi et al. (2014) focus on fiscal transfers, Farhi and Werning (2017) consider fiscal devaluations, Farhi et al. (2014), Schmitt-Grohé and Uribe (2016) and Sergeyev (2016) study macroprudential policies, while Aguiar et al. (2015) focus on public debt and rollover crises. A smaller body of work has studied the benefits derived from creating a monetary union. For instance, in Rey (2001) sharing a common currency reduces the cost of performing international transactions. In Nurkse (1944), Jeanne and Rose (2002) and Gabaix and Maggiori (2015) flexible exchange rates, rather than acting as shock absorbers, can be a source of volatility by triggering speculative flows. None of these papers study the impact of the exchange rate regime on financial integration.

The notion that creating a monetary union leads to higher financial integration goes back at least to Ingram (1973), but few attempts have been made at formalizing this insight. To the best of my knowledge, in fact, the only two exceptions are Arellano and Heathcote (2010) and Doepke and Schneider (2017). In Arellano and Heathcote (2010) governments finance their expenditure through seignorage or foreign borrowing, and they are punished with exclusion from credit markets in case of default. Fixing the exchange rate - and so giving up seignorage - exacerbates the

cost of being excluded from the credit markets and thus increases the government's debt limit. The key friction in Doepke and Schneider (2017) is that financial contracts are non-contingent and defaulting generates social losses. Sharing a common currency leads to higher international financial integration because it limits the probability that agents default in response to exogenous shocks. The channel emphasized by this paper is very different. In fact, my argument does not rest on the existence of seignorage or the inability to write contingent contracts, but rather on the combination of nominal wage rigidities and collateral constraints. Moreover, in Arellano and Heathcote (2010) and Doepke and Schneider (2017) increasing financial integration is welfare improving. Here, instead, higher financial integration can generate financial instability and welfare losses.

In my model joining a currency union fosters financial integration because it prevents national governments from using exchange rate depreciations to expropriate foreign investors. Tirole (2003) provides a general theory in which placing constraints on government policy facilitates international borrowing, because it limits the government's ability to expropriate foreign investors. A similar argument is present in Jeanne (2009), who focuses on the optimal debt maturity structure. Here I consider an alternative channel through which expropriation can occur, arising from the impact of monetary policy on collateral value. Moreover, both Tirole (2003) and Jeanne (2009) consider a single country. Instead, a key element of this paper is its multi-country dimension, and in particular the fact that forming a currency union facilitates financial flows both in and out of member countries. Because of this reason, the impact of higher financial integration on welfare is ambiguous in my model, while it is positive in Tirole (2003) and Jeanne (2009).

Also in Fornaro (2015), Ottonello (2013) and Coulibaly (2018) monetary policy affects collateral value because of the presence of nominal wage rigidities. In their settings, however, the time-consistency problem described by this paper does not arise. The reason is that Fornaro (2015), Ottonello (2013) and Coulibaly (2018) assume that monetary policy is set before financial contracts are signed and collateral is posted. Effectively, this means that national governments can commit not to use monetary policy to expropriate foreign investors. Moreover, Fornaro (2015), Ottonello (2013) and Coulibaly (2018) focus on a single small open economy facing an exogenously given world interest rate. Instead, this paper studies a multi-country economy, in which global credit markets clear and the world interest rate is endogenously determined. Due to this feature, the exchange rate regime affects the potential for capital outflows by domestic agents, a dimension which is absent in Fornaro (2015), Ottonello (2013) and Coulibaly (2018).

Finally, this paper is connected to the literature emphasizing how increasing international financial integration can have an ambiguous impact on welfare. Two examples are Martin and Rey (2006) and Broner and Ventura (2016). In both papers, a high degree of financial integration may open the door to pessimistic equilibria characterized by inefficient capital flights. However, these papers take the level of international financial integration as determined by exogenous forces. Here financial integration is endogenously determined, and depends on the exchange rate regime.

The rest of the paper is composed of five sections. Section 2 presents the baseline model.

Section 3 describes the connection between the exchange rate regime and financial integration. Section 4 derives the implications for capital flows and welfare. Section 5 discusses some policy implications for monetary unions. Section 6 concludes. The Appendix contains all the proofs and derivations not included in the main text.

2 Model

Consider a world composed of two countries, home and foreign. There are two periods: 0 and 1. In period 0 agents sign financial contracts and make their investment decisions. In period 1 production takes place, financial contracts are settled and agents consume. Agents are rational and there is perfect foresight.

To simplify the exposition, while presenting the model I will focus on the home economy. The foreign country is, however, characterized by exactly the same equilibrium conditions. When needed, I will denote variables pertaining to the foreign country with $*$ superscripts.

2.1 Households

The home country is populated by a continuum of measure one of identical households. Households consume and work in period 1 only, and their utility is

$$C_T + \frac{C_N^{1-\eta}}{1-\eta} - L.$$

In this expression, C_T and C_N denote respectively consumption of a tradable and a non-tradable good, while L denotes labor effort.[6]

In period 0 households are endowed with N units of the tradable good. There are two assets in which households can invest to transfer tradable goods to period 1. First, households can invest in a domestic technology, call it capital, that transforms one unit of the tradable good in period 0 into A units of the tradable good in period 1. Let I denote investment in home-country capital. In addition, households have access to a real bond denominated in units of the tradable good. Denote by D the level of debt assumed by domestic households in period 0 and due in period 1, and R the gross interest rate between the two periods. The bond is traded internationally, and R is common across the two countries.

The period 0 budget constraint of home households is thus given by

$$I = N + \frac{D}{R}. \tag{1}$$

[6]The assumption that utility is linear in consumption of the tradable good is key in order to solve the model analytically. Instead, the assumption that disutility from labor effort is linear is made purely to simplify notation, and could be easily relaxed.

Moreover, as it will become clear later on, each household faces a borrowing limit

$$D \leq \bar{D}.$$

Households' optimal investment strategy is then

$$I = \begin{cases} N + \frac{\bar{D}}{R} & \text{if } A > R \\ \left[0, N + \frac{\bar{D}}{R}\right] & \text{if } A = R \\ 0 & \text{if } A < R. \end{cases} \tag{2}$$

Intuitively, if $A > R$ households maximize investment in domestic capital by borrowing up to their limit. Instead, if $A < R$ investment in domestic capital is unprofitable, and households lend all their net worth on the international credit markets. Finally, if $A = R$ households are indifferent between investing in domestic capital and lending on the credit markets.

In period 1 households receive the return from period 0 investment, work and consume. Their period 1 budget constraint in terms of the home currency is

$$P_T C_T + P_N C_N = P_T Y_T - P_T \mathcal{R} + WL.$$

The left-hand side of this expression represents the households' expenditure. P_T and P_N denote respectively the price of a unit of tradable and non-tradable good in terms of the home currency. Hence, $P_T C_T + P_N C_N$ is the total nominal expenditure in consumption. Since period 1 is the terminal date of the economy, households hold no assets at the end of the period.

The right-hand side captures the households' income. Y_T denotes the output of tradable goods produced by the home country in period 1, given by

$$Y_T = AI. \tag{3}$$

$\mathcal{R}$ is the amount of loan repayment that households make in period 1. W denotes the nominal wage, and hence WL is the households' labor income.

In period 1, households have two decisions to make. First, each household chooses whether to honor its debt or default. In case of default, creditors appropriate a fraction κ of the household's income, so that the household is left with the complement fraction $1 - \kappa$. Clearly, households default if the value of the debt owed to foreign investors exceeds the value of the collateral that is repossessed upon default. This implies that

$$\mathcal{R} = \min\left[D, \kappa\left(Y_T + \frac{W}{P_T}L\right)\right].$$

Intuitively, the payment that households make to their creditors cannot exceed the value of their collateral.

Second, households allocate expenditure between the two consumption goods. This leads to the demand function for non-tradable goods

$$C_N = \left(\frac{P_N}{P_T}\right)^{-\frac{1}{\eta}}. \tag{4}$$

Demand for non-tradables is thus decreasing in their relative price P_N/P_T.

2.2 Nominal wage rigidities

To allow for real effects from monetary policy, I introduce a simple friction in the adjustment of nominal wages. In particular, nominal wages are fixed and equal to W. This could be the result, for instance, of large menu costs from changing wages. To clear the labor market, I then assume that households satisfy firms' labor demand.

To be clear, the results that follow do not rely at all on this extreme form of wage rigidity, and would extend to a setting in which partial adjustment of nominal wages is possible. But considering an economy with fixed wages is convenient, because it simplifies the analysis and allows for a transparent characterization of the economic forces at the heart of the model.

2.3 Non-tradable production and the real exchange rate

Non-traded output Y_N is produced by a large number of competitive firms. Labor is the only factor of production, and the production function is $Y_N = L$. Profits are given by $P_N Y_N - WL$. The zero profit condition implies that in equilibrium $P_N = W$.

The real exchange rate of the home economy, denoted by p, can thus be written as

$$p = \frac{P_N}{P_T} = \frac{W}{P_T}. \tag{5}$$

Notice that, since the nominal wage is rigid, changes in the nominal price of the tradable good affect the real exchange rate. In fact, as I will explain later on, this is the channel through which monetary policy affects the real economy.

2.4 Market clearing and equilibrium

Market clearing for the non-tradable consumption good requires that domestic consumption is equal to domestic production

$$Y_N = C_N. \tag{6}$$

Combining this condition with equation (4) gives

$$Y_N = p^{-\frac{1}{\eta}}. \tag{7}$$

Hence the real exchange rate, through its impact on demand, effectively determines production of non-tradable goods.

In equilibrium, tradable consumption must be equal to tradable output less the payment made to foreign creditors

$$C_T = Y_T - \min\left[D, \kappa\left(Y_T + pY_N\right)\right]. \tag{8}$$

This equation highlights how collateral is equal to the value of the country's output in terms of the tradable good.[7]

Combining (7) and (8) gives an expression linking the value of collateral to the real exchange rate

$$\kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right).$$

In principle, the relationship between the real exchange rate and collateral value is ambiguous and depends on η. For the results that follow the only requirement is that movements in the real exchange rate affect collateral value, and so that $\eta \neq 1$. But, purely to simplify the exposition, from now on I will assume that $\eta > 1$.[8] In this case, a real exchange rate depreciation reduces the value of collateral. Analogous market clearing conditions hold for the foreign economy.

Finally, the global market clearing conditions are

$$N + N^* = I + I^* \tag{9}$$

$$C_T + C_T^* = Y_T + Y_T^*. \tag{10}$$

Equation (9) ensures that global investment in capital is equal to the world endowment of the tradable good in period 0. Equation (10) implies that period 1 global consumption of tradable goods is equal to global production.

We are now ready to define a competitive equilibrium.

Definition 1 *A competitive equilibrium is a set of real allocations* $\{C_T, C_T^*, C_N, C_N^*. Y_T, Y_T^*, Y_N, Y_N^*, I, I^*, D, D^*\}$ *and world interest rate* R*, satisfying* (1), (2), (3), (6), (7), (8) *- plus their counterparts for the foreign country - and* (10)*, given policy-determined values for the real exchange rates* $\{p, p^*\}$ *and for the debt limits* $\{\bar{D}, \bar{D}^*\}$*.*

2.5 Discussion of assumptions

The key feature of the model is that monetary policy can influence the payment that foreign creditors receive from domestic agents. This happens because monetary policy affects production of non-traded goods, which in turn is used as collateral to back up financial transactions. However, several other assumptions would give rise to similar results. For instance, one could consider a setting in which collateral is given by some long-lived asset, such as capital, land or housing. As

[7] To gain intuition about this expression, consider that foreign creditors cannot consume home non-traded goods. Hence, when foreigners repossess units of non-tradable goods from defaulting debtors they need to sell them on the market in exchange for tradable goods.

[8] Assuming a constant elasticity of substitution aggregator for consumption, η would capture the elasticity of substitution between tradable and non-tradable goods. As discussed by Ottonello (2013), the empirical evidence points toward values of η greater than one.

long as monetary policy has an impact on the foreign currency value of this asset, as for instance in Fornaro (2015), the main results of the paper go through.

Another possibility is to consider debt contracts denominated in domestic currency. Also in this case, in fact, monetary policy would affect the payment received by foreign creditors. However, as documented empirically by Maggiori et al. (2019), foreign creditors rarely accept to sign debt contracts denominated in domestic currency. This is the reason why the model considers debt contracts denominated in real terms, which cannot be directly affected by monetary policy. In fact, one could even assume that agents sign equity - rather than debt - contracts. As long as their payment is backed up by collateral, all the main results would still apply.

Finally, let me clarify that all the results that follow would go through if one were to assume that $\eta < 1$. The only difference is that in this case monetary authorities would need to appreciate the exchange rate in order to expropriate foreign investors. The same consideration applies to the model studied by Fornaro (2015), in which an exchange rate depreciation increases land price and collateral value. Also in this case, the only substantial difference is that the expropriation of foreign investors would take place through an appreciation of the exchange rate.

3 Exchange rate regime and financial integration

What is the relationship between monetary policy, the exchange rate regime and financial integration? To answer this question, I solve the model backward and start by characterizing the equilibrium in period 1. Throughout I will contrast two different policy regimes. First, I will consider the case of flexible exchange rates. Later on, in Section 3.2, I will turn to the case of a monetary union.

3.1 Flexible exchange rates

In this simple model monetary policy amounts to setting a value for the nominal price of the tradable good.[9] Under flexible exchange rates each country can run its own independent monetary policy. To see this point start by considering that for the tradable good the law of one price holds and so

$$P_T = SP_T^*,$$

where S denotes the nominal exchange rate, defined as the units of home currency needed to purchase one unit of the foreign currency. The key observation is that the nominal price of the

[9]For instance, imagine that in period 1 the monetary authority in the home country sets the money supply M. Now suppose that households need money to purchase consumption goods, so that

$$P_T C_T + P_N C_N = M.$$

Using (4), (5) and (8) the expression above can be written as

$$P_T \left(Y_T - \min \left[D, \kappa \left(Y_T + W^{1-\frac{1}{\eta}} P_T^{\frac{1}{\eta}} \right) \right] \right) + W^{1-\frac{1}{\eta}} P_T^{\frac{1}{\eta}} = M.$$

Since Y_T, D, and W are all predetermined in period 1, by setting M the monetary authority controls P_T.

traded good can differ across the two countries, because the nominal exchange rate adjusts to make sure that the law of one price holds. Thus, under flexible exchange rates national governments can freely control the domestic nominal price of the traded good. Since nominal wages are rigid, the implication is that national governments can effectively choose a value for their real exchange rate.

Closing the model requires specifying how monetary policy is conducted. I consider governments that implement the optimal non-cooperative monetary policy. Therefore, each government chooses the value of the domestic real exchange rate to maximize the welfare of its country's citizens, without any concern for welfare in the rest of the world. Moreover, each government operates under discretion. This means that governments set monetary policy in period 1, without being restricted by any promise that they might have made in period 0.

For instance, in period 1 the home government chooses p, Y_N and C_T to maximize home households' utility

$$C_T + \frac{Y_N^{1-\eta}}{1-\eta} - Y_N,$$

where I have used the equilibrium conditions $C_N = Y_N = L$. Utility is maximized subject to

$$Y_N = p^{-\frac{1}{\eta}}$$

$$C_T = Y_T - \min\left[D, \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)\right].$$

Hence, by setting p the government affects two margins. First, p determines the quantity of non-tradable goods produced and consumed by domestic households. Second, if the home country is in a default state, the real exchange rate has an impact on the value of the collateral that foreign creditors can repossess from domestic agents.

I will characterize the government policy in two steps.[10] The first step consists in deriving the government policy, conditional on whether the country is in a default state or not. Start by assuming that $D < \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$, so that home agents do not default. Then it is optimal for the home government to set

$$p = 1 \rightarrow Y_N = 1.$$

To understand the intuition behind this condition, consider that $Y_N = 1$ is the natural level of non-tradable output, that is the amount of non-tradable goods that the economy would produce in absence of nominal rigidities.[11] Hence, conditional on no default, the optimal monetary policy offsets the impact of nominal rigidities on production.

Now imagine that $D > \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$, so that home households are defaulting on their creditors. In this case the home government sets

$$p = (1 + \kappa(\eta - 1))^{-1} < 1 \rightarrow Y_N > 1.$$

[10] See Appendix A.1 for a detailed derivation of the solution to the government problem.

[11] In fact, notice that when $Y_N = 1$ the marginal utility of non-tradable consumption ($Y_N^{-\eta}$) and the marginal disutility from working (1) are equalized.

Intuitively, in case of default the government has an additional incentive to depreciate the exchange rate. An exchange rate depreciation, in fact, reduces the value of collateral and thus the amount of tradable goods that foreign creditors can extract from domestic households. The counterpart of this exchange rate depreciation is the overheating of the domestic economy, in the sense that output of non-tradable goods ends up being above its natural level ($Y_N > 1$). So, conditional on defaulting, the home government trades off the gains from depreciating the exchange rate to expropriate foreign creditors, with the costs associated with an inefficiently high production of the non-tradable good.

The second step consists in deriving the conditions under which default occurs. Intuitively, the country ends up defaulting whenever doing so delivers higher welfare compared to repaying. After some algebra, one finds that default occurs if

$$D > \kappa Y_T + \frac{\eta}{\eta - 1}\left[(1 + \kappa(\eta - 1))^{\frac{1}{\eta}} - 1\right] \equiv \bar{D}_{flex}.$$

Naturally, the country defaults whenever its debt toward foreign agents is too high. In particular, default occurs whenever foreign debt exceeds the threshold $\bar{D}_{flex}$. The following proposition summarizes these results.[12]

Proposition 1 *Under flexible exchange rates, the home country does not default if and only if* $D \leq \bar{D}_{flex}$. *Moreover, in absence of default monetary policy sets* $p = Y_N = 1$. *Analogous expressions hold for the foreign country.*

A couple of remarks are in order. First, since agents are rational, anticipating the government policy investors will never be willing to lend to domestic agents more than $\bar{D}_{flex}$. It follows that the debt ceiling imposed by foreign investors under flexible exchange rates is $\bar{D} = \bar{D}_{flex}$. This also means that countries never accumulate enough debt to trigger a default, and so in equilibrium monetary policy sets $p = Y_N = 1$ to replicate the allocation under flexible wages.

Second, under flexible exchange rates the debt ceiling imposed by foreign investors is lower than the value of collateral. In fact, it is easy to check that

$$\bar{D}_{flex} < \kappa\left(Y_T + pY_N\right) = \kappa\left(Y_T + 1\right).$$

This happens because foreign investors anticipate that, if they were to lend to a country slightly more than $\bar{D}_{flex}$, the domestic government would engineer a discrete depreciation of the real exchange rate. In turn, the depreciation would trigger a discrete fall in the value of collateral. Hence, under flexible exchange rates, a naive observer would conclude that borrowers never borrow enough to exhaust the value of their collateral.[13]

[12] Appendix *A* contains all the proofs.

[13] Obstfeld and Rogoff (1996) show that a similar result applies when the return from investment in physical capital is used as collateral, and agents decide their investment strategy after credit contracts are signed (see Chapter 6, Section 2). In their setting, debtors have an incentive to reduce investment in order to decrease the value of collateral, and thus the resources that creditors repossess in case of default. This implies that a small increase in debt can trigger a discrete fall in investment and collateral value.

To end this section, notice that under flexible exchange rates the government is subject to a standard time-consistency problem. In period 0, in fact, the government would like to commit not to depreciate the exchange rate in period 1. This would relax the borrowing limit imposed by investors on domestic agents. However, when period 1 comes the government has an incentive to forget its past promises and to expropriate foreign creditors through a depreciation. In absence of commitment, the period 0 promise not to devalue the exchange rate ex post is thus not credible.

3.2 Monetary union

I now turn to the case of a monetary union. In a monetary union the two countries share the same currency and so $S = 1$. The law of one price for the tradable good then implies that $P_T = P_T^*$, so that differences in the nominal price of tradables across countries cannot arise. Moreover, monetary policy is no longer controlled by national governments. It is instead set by a supranational authority, the union's central bank.[14]

To parallel the case of flexible exchange rates, I consider a benevolent central bank that operates under discretion. The difference is that the central bank of the union seeks to maximize the welfare of the union as a whole. In particular, I consider a central bank that attaches equal weight to the welfare of every citizen of the union.

In principle, the home and foreign country could have different pre-set nominal wages. To keep the analysis transparent, it is however convenient to assume that $W = W^*$. Under this assumption, both countries feature the same real exchange rate and the same production of non-traded goods ($p = p^*$, $Y_N = Y_N^*$).

The union's central bank thus maximizes

$$Y_T + Y_T^* + 2\left(\frac{Y_N^{1-\eta}}{1-\eta} - Y_N\right),$$

where I have used the market clearing condition $C_T + C_T^* = Y_T + Y_T^*$, subject to

$$Y_N = p^{-\frac{1}{\eta}}.$$

It is immediate to see that the solution to this problem is

$$p = 1 \rightarrow Y_N = Y_N^* = 1.$$

To understand this result, consider that from the point of view of the union's central bank it does not matter how tradable consumption is distributed across the two countries. Hence, the central bank of the union has no incentives to use monetary policy to redistribute resources across home and foreign agents.[15] Instead, the optimal policy focuses on offsetting the impact of nominal

[14] For simplicity, and in accordance with most of the literature on monetary unions, I assume that exiting the union is prohibitively costly, so that countries can credibly commit to their participation. It would not be hard to extend the analysis to cases in which exit costs are finite.

[15] This result would be slightly different if the utility that households derive from consumption of tradable goods

rigidities on output, so that production of non-traded goods in both countries is equal to their natural level.[16]

The implication is that the home country does not default as long as

$$D \leq \kappa \left(Y_T + pY_N \right) \equiv \bar{D}_{mu}.$$

The debt ceiling imposed by foreign investors is thus exactly equal to collateral value, and so $\bar{D} = \bar{D}_{mu}$.

Proposition 2 *In a monetary union, the home country does not default if and only if* $D \leq \bar{D}_{mu}$. *Moreover, assuming* $W = W^*$, *monetary policy sets* $p = Y_N = 1$. *Analogous expressions hold for the foreign country.*

Intuitively, forming a monetary union mitigates the time-consistency problem faced by national central banks. This happens because the union's central bank, which attaches equal weight to the welfare of both debtors and creditors, has no incentives to use the exchange rate to decrease collateral value and expropriate investors.[17]

3.3 Impact of forming a monetary union on financial integration

We are now ready to trace the impact of forming a monetary union on financial integration. First, notice that the exchange rate regime does not affect the equilibrium value of the real exchange rate or non-tradable output. The exchange rate regime, however, does affect the tightness of the international borrowing constraints that agents face in period 0. In fact, it is easy to see that

$$\bar{D}_{mu} > \bar{D}_{flex}.$$

Creating a monetary union thus increases the stock of foreign debt that home agents can sustain without defaulting. Moreover, since the two countries are symmetric, it is also the case that

$$\bar{D}^*_{mu} > \bar{D}^*_{flex}.$$

was concave. In that case, in fact, the central bank would have an incentive to redistribute wealth from rich to poor households. Still, the incentive to expropriate investors would be much milder compared to the case of flexible exchange rates, since the central bank of the union would take into account the negative impact of this expropriation on creditors' welfare.

[16] With $W \neq W^*$, it would not be possible for the central bank of the union to replicate the allocation with flexible wages. In this case, up to a first-order approximation, the optimal monetary policy would be such that $(Y_N + Y^*_N)/2 = 1$ (see Benigno (2004) for a derivation of an analogous result in the standard New-Keynesian open-economy model). The optimal monetary policy would thus essentially eliminate the impact of nominal rigidities on the aggregate output of the union. Still, the central bank of the union would have no incentives to affect the value of collateral in order to redistribute wealth across the two countries.

[17] To be precise, forming a monetary union does not completely solve the time-consistency problem. In fact, in period 0 the central bank of the union might have an incentive to promise a deviation of output from its natural level in period 1, so as to increase collateral value. When period 1 comes, however, it will be optimal for the central bank to renege on its past promises, so as to replicate the allocation with flexible wages.

This means that also the assets that home agents can hold abroad without triggering a default by the foreign country increases when a monetary union is formed.

Hence, compared to the case of flexible exchange rates, countries in a monetary union can both absorb higher amounts of foreign debt and lend larger sums abroad. Adopting a single currency thus fosters financial integration across member countries, by increasing international capital mobility. This happens because joining a currency union imposes a *vincolo esterno* - i.e. an external constraint - on national policymakers, preventing them from using monetary policy to expropriate foreign creditors.

4 Capital flows and welfare

We have just seen that forming a monetary union increases financial integration. But does this process lead to efficient capital flows and higher welfare? To answer this question we need to fully characterize the equilibrium of the model. It turns out that the answer is not clear cut. To make this point, I will start by describing a scenario in which forming a monetary union unambiguously increases welfare. I will then turn to a scenario in which adopting a common currency might generate welfare losses by inducing financial instability and capital misallocation.

4.1 The benign view

Let us start by considering a simple case in which the return from investing in capital is higher in the home country compared to the foreign one ($A^* < A$). This return differential induces home agents to borrow from foreigners to finance investment in domestic capital.[18] Home investment is then equal to

$$I = N + \min\left(N^*, \frac{\bar{D}}{A^*}\right).$$

To interpret this condition, consider that there are two possible cases. First, it might be that home agents' debt ceiling is large enough so that all the savings are channeled toward the home country ($I = N + N^*$). Instead, if home agents' debt ceiling is tight enough the home country will not be able to absorb the entire stock of global savings. In this case, the interest rate must be such that foreign agents are indifferent between investing in foreign capital or lending to home agents ($R = A^*$) and home investment will be equal to $I = N + \bar{D}/A^*$.

Let us now focus on a scenario in which under flexible exchange rates only part of global savings are invested in the home country. This is the case if the following assumption holds.

Assumption 1 *The parameters are such that*

$$N^* > \frac{\kappa A N + \frac{\eta}{\eta-1}\left[(1+\kappa(\eta-1))^{\frac{1}{\eta}} - 1\right]}{A^* - \kappa A} > 0. \tag{11}$$

[18] In accordance with most of the literature, here I assume that households can commit to an investment plan designed before credit contracts are signed. See Obstfeld and Rogoff (1996) (Chapter 6, Section 2) for a discussion of this assumption.

These inequalities ensures that credit constraints are tight enough so that home agents are not able to absorb all foreign savings. In particular, the second inequality implies that the credit multiplier $\kappa A/A^*$ is smaller than 1, so that an increase in investment by one unit generates less than a unit increase in collateral value.

Now consider what happens if the two countries form a monetary union. As discussed above, the borrowing limit $\bar{D}$ increases. Once a monetary union is created, therefore, more capital ends up flowing toward the high-return home country. The international allocation of capital thus becomes more efficient, and global production of tradable goods increases. Since equilibrium production of non-traded goods does not depend on the exchange rate regime, higher output of tradables leads to higher welfare.[19]

Proposition 3 *Suppose that $A > A^*$ and that assumption 1 holds. Then moving from flexible exchange rates to a monetary union produces an increase in global output of tradable goods and welfare.*

There are two points worth mentioning. First, in this model forming a monetary union increases welfare only if member countries are asymmetric in terms of their investment opportunities. Indeed, if $A = A^*$ there are no welfare gains from sharing a common currency. This contrasts with the traditional optimal currency area literature, in which giving up exchange rate flexibility is costly precisely when countries are hit by asymmetric shocks. Second, forming a monetary union has a positive impact on welfare only if under flexible exchange rates credit frictions prevent capital from being allocated efficiently across countries. Hence, it is optimal to form a currency union only if financial markets are not too developed to start with.[20]

The results presented so far are in line with Ingram's view. Forming a monetary union boosts financial integration, and leads to a more efficient allocation of capital across member countries. But, as I will show next, such a benign view is not the only possibility.

4.2 The not-so-benign view

Compared with the recent experience of the euro area, the benign view of the previous section seems to be at best incomplete. The euro area crisis, in fact, was characterized by high volatility in financial markets and sharp reversals in capital flows. Summarizing the existing literature, Akerlof (2019) argues that episodes of financial instability can be rationalized with the existence of complementarities in investment decisions among agents. This section builds on this notion and shows that, in presence of investment complementarities, forming a monetary union might lead to coordination failures among agents, capital misallocation and welfare losses. The key insight is

[19] Gourinchas and Jeanne (2006) find that the welfare gains strictly related to a better allocation of physical capital across countries are small, especially if compared to the welfare gains from increasing productivity. However, it is not hard to think of channels through which higher financial integration can lead to an increase in total factor productivity. For instance, as in Howitt and Aghion (1998), one could assume that investment in physical capital and innovation are complements. In Gourinchas and Jeanne (2005), instead, inflows of foreign capital can induce the government to implement reforms aiming at increasing productivity.

[20] Formally, this is captured by the conditions stated in assumption 1, which hold for sufficiently low values of κ.

that high financial integration facilitates large and swift movements of capital across countries. In turn, a high degree of capital mobility may open the door to episodes of inefficient capital flights driven by pessimistic expectations.

Complementarities in investment decisions arise when the private return to investing is increasing in aggregate investment. Though several options are possible, I will focus on increasing returns arising from a fiscal externality. In a nutshell, capital taxation influences the private return from investing. But, since the tax base depends on the capital stock, investment affects the level of taxation. As shown by Eaton (1987) and Velasco (1996), this complementarity can give rise to episodes of inefficient capital flights driven by animal spirits. Intuitively, expectations of high taxes on capital depress investment, and therefore the tax base. A low tax base forces the government to impose a high tax rate to finance its expenditures, validating agents' initial expectations. This story is reminiscent of some aspects of the recent euro area crisis, during which capital flights from peripheral to core countries coincided with fiscal stress.[21] I will now show that, under certain conditions, monetary unions can be particularly prone to experience these episodes of inefficient capital flights.[22]

Suppose that the government in the home country has to finance an exogenous spending in period 1, equal to G units of the tradable good. This fiscal expenditure could represent the cost of solving a domestic banking crisis, result from the kick in of automatic stabilizers during a deep recession, or be the consequence of the spread of a pandemic. This assumption could also capture a public debt overhang scenario, in which high public expenditure derives from interest payments on a large stock of inherited public debt.[23] It does not matter too much how government expenditure affects households' utility. In fact, the results that follow hold regardless of whether government expenditure is a pure waste, it is rebated to domestic households through lump-sum transfers or it enters directly households' utility function, as long as utility is separable in government expenditure.

Government expenditure has to be financed through taxes. The important friction here is that the bulk of taxation falls on domestic investment, because the government has a limited ability to tax revenues earned abroad by its citizens.[24] For simplicity, I will assume that the fiscal expenditure has to be financed entirely through a tax on domestic capital. The government budget constraint can thus be written as $G = \tau Y_T$, where τ is a proportional tax on the return to capital. I will also assume that there is an upper bound $\bar{\tau}$ on the tax rate that the government can impose.[25] In case

[21] See, for instance, Chapter 2 of the October 2012 edition of the IMF Global Financial Stability Report.

[22] To be clear, the results presented below do not restrict themselves to the case of fiscal externalities. In fact, one can think of many other sources of coordination failures in investment decisions that would lead to similar results. For instance, in Appendix B I consider a setting in which increasing returns in investment arise from technological spillovers. Another possibility, following Gourinchas and Jeanne (2005), is to consider a case in which the return from investment depends on some productivity-enhancing reform that the government might implement after investment decisions are taken.

[23] There are thus some similarities with Lamont (1995), who shows that private debt overhang can give rise to equilibrium multiplicity by inducing agents to make socially inefficient investment decisions.

[24] For instance, imagine that the government had to finance its expenditure by taxing deposits in the domestic banking sector, without being able to tax deposits held abroad by domestic agents.

[25] This assumption is required to rule out an extreme equilibrium in which agents anticipate a 100% tax on capital, inducing them to completely avoid investing in the home country. Alternatively, one could rule out this extreme

the upper bound on the tax is reached, the government is forced to lower expenditure to satisfy its budget constraint. The private return to investing in capital at home is then given by

$$A(1-\tau) = A\left(1 - \max\left(\frac{G}{Y_T}, \bar{\tau}\right)\right) \equiv \tilde{A}, \tag{$\tilde{A}$}$$

where $\tilde{A}$ denotes the after-tax return on home investment. This expression highlights how the presence of a fiscal externality introduces increasing private returns to investment. As the domestic capital stock increases, in fact, the tax base gets larger, allowing the government to reduce the tax rate. Atomistic agents do not internalize this effect, since they are too small to take into account the impact of their investment decisions on taxes.

When choosing their investment strategy, agents compare the after-tax return from investing in domestic capital to the interest rate. In turn, the interest rate depends on the relative return from investment in the home and foreign country. To simplify the exposition, I will restrict attention to interior equilibria in which investment is positive in both countries. This happens if agents' borrowing capacity is low enough compared to the supply of savings. To ensure that this is the case, I will make the following parametric assumptions.

Assumption 2 *The parameters are such that*

$$N^* > \frac{\kappa\left(AN+1\right)}{A^* - \kappa A} > 0 \tag{12}$$

$$N > \frac{\kappa\left(A^*N^*+1\right)}{A(1-\bar{\tau}) - \kappa A^*} > 0. \tag{13}$$

We now have three possible cases to consider. First imagine that the after-tax return from investing in the home country is high enough so that $\tilde{A} > A^*$. Then home agents maximize investment in domestic capital, by borrowing as much as possible from abroad. The equilibrium interest rate is then equal to A^*, to ensure that foreign agents are indifferent between investing domestically and lending on the international credit markets. Now suppose that the after-tax return to home investment is low, so that $\tilde{A} < A^*$. Then home agents maximize lending on the international credit markets. The equilibrium interest rate is equal to $\tilde{A}$, so that home agents are indifferent between investing in domestic capital and lending to foreign agents. Finally, if $\tilde{A} = A^*$ agents are indifferent between investing at home or in the foreign country, and the equilibrium interest rate is A^*.

Following the logic outlined above, we can derive an expression relating production of tradable

equilibrium by assuming that investment in capital is irreversible, and that the home country enters period 0 with some pre-installed capital.

goods in the home country to the after-tax return on home investment

$$Y_T = \begin{cases} A\left(N + \frac{\bar{D}}{A^*}\right) & \text{if } \tilde{A} > A^* \\ \left[A\left(N - \frac{\bar{D}^*}{A^*}\right), A\left(N + \frac{\bar{D}}{A^*}\right)\right] & \text{if } \tilde{A} = A^* \\ A\left(N - \frac{\bar{D}^*}{\tilde{A}}\right) & \text{if } \tilde{A} < A^*. \end{cases} \tag{I}$$

There are two observations to make. First, as it is natural, a lower tax rate on home investment induces a (weakly) higher production of tradable goods in the home country. Second, the impact of changes in taxes on investment depends on the ease with which capital can be moved across the two countries, as captured by the debt ceilings $\bar{D}$ and $\bar{D}^*$. In particular, higher debt limits correspond to stronger reactions of investment and production to changes in taxes.

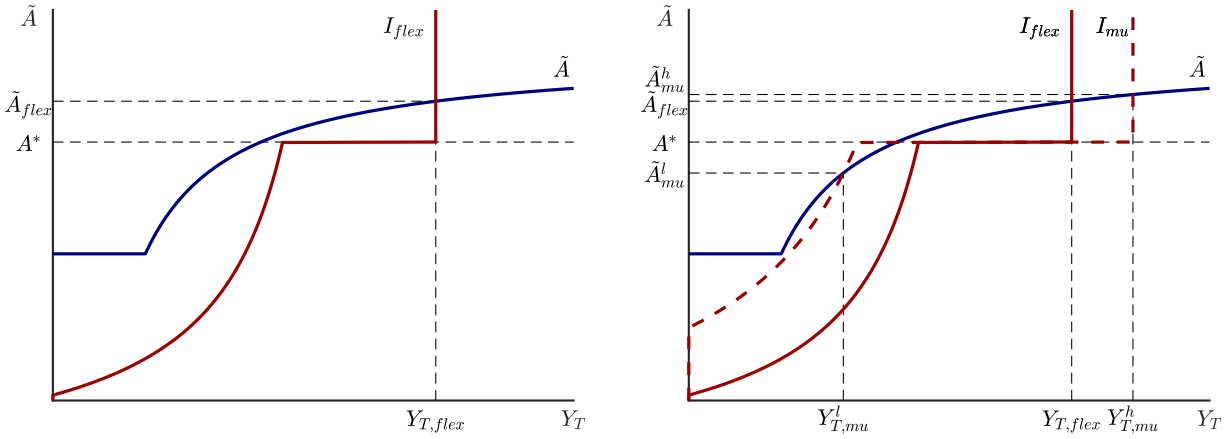
The schedules $\tilde{A}$ and I describe two increasing relationships between the tax rate on capital and production of tradable goods. As stated by the following proposition, the feedback loop between these two variables can be strong enough to generate multiple equilibria.

Proposition 4 *Suppose that the parameters satisfy the conditions stated by assumption 2. If* $G < (A - A^*)(N + \bar{D}/A^*)$ *there exists a unique stable capital inflows equilibrium in which home agents borrow up to the limit and maximize investment in domestic capital. If* $G > (A - A^*)(N - \bar{D}^*/A^*)$ *there exists at least one stable capital flight equilibrium in which home agents maximize lending to foreign agents. Therefore if* $(A - A^*)(N - \bar{D}^*/A^*) < G < (A - A^*)(N + \bar{D}/A^*)$ *there are multiple stable equilibria. If multiple equilibria are possible, global output and welfare are higher in the capital inflow equilibrium compared to the capital flight equilibria.*

Proposition 4 implies that if G is sufficiently small there is a *capital inflows equilibrium*, in which the after-tax return from investing at home is higher than the interest rate and capital flows toward the home country. If G is large enough, instead, *capital flight equilibria* are possible. In these equilibria the after-tax return from investing at home is lower than the return from investing in the foreign country. Therefore capital flies toward the foreign country. Fiscal externalities can thus distort the international allocation of capital, by inducing capital flows toward the country in which investment is least productive. Moreover, for intermediate values of G both type of equilibria coexist. In this case, agents' expectations determine which equilibrium materializes. These results essentially extend the findings of Eaton (1987) and Velasco (1996) to this setting.

Proposition 4 also establishes a novel link between the exchange rate regime and the international allocation of capital. Notice that according to Proposition 4 the degree of international financial integration, as captured by the debt ceilings $\bar{D}$ and $\bar{D}^*$, is a key determinant of whether capital flows into or flies from the home country. The exchange rate regime, through its impact on financial integration, can therefore affect the direction of capital flows.

It is not hard to construct a scenario under which forming a monetary union can worsen the international allocation of capital. This point can be seen most clearly by looking at Figure 1, which visually represents the $\tilde{A}$ and I schedules in the $Y_T - \tilde{A}$ space. An equilibrium corresponds



(a) Unique equilibrium with flexible exchange rates **(b) Multiple equilibria in a monetary union**

Figure 1: Exchange rate regime and capital flows.

to a point in which the two curves intersect.

Imagine that under flexible exchange rates there is a unique equilibrium characterized by capital inflows toward the home country. This case is shown by panel (a). As highlighted by Proposition 4, a capital inflow equilibrium exists under flexible exchange rates if $G < (A - A^*)(N + \bar{D}_{flex}/A^*)$. Intuitively, this condition ensures that with capital inflows the tax base in the home country is large enough to guarantee that the after-tax return from investing at home is higher than the interest rate.

It is useful to pause for a second and consider why the capital flight equilibria are instead ruled out. Imagine that agents anticipate that the after-tax return from investing at home will be lower than A^*. In this case, the home country will experience a capital flight. However, if foreign agents' debt limit is tight, the capital flight will have a small impact on investment, on the tax base and so on the tax rate. But then the return from investing at home will not fall below A^*, contradicting the initial pessimistic expectations.[26] In this scenario, therefore, under flexible exchange rates expectations-driven capital flights cannot take place because international capital mobility is too low.

What might happen if the two countries adopt a common currency? A possible outcome is displayed by panel (b). Once a currency union is formed financial integration increases, leading to a rise in the borrowing limits $\bar{D}$ and $\bar{D}^*$. Domestic agents can now sustain a higher amount of foreign debt. Hence, if $\tilde{A} > A^*$, home agents increase their foreign borrowing and more capital is installed in the home country. Graphically, this is captured by the rightward shift in the I schedule. This implies that, if expectations coordinate on the capital inflow equilibrium, forming a monetary union leads to a more efficient international allocation of capital and to higher global production of tradable goods.

[26] Formally, this is the case if $G < (A - A^*)(N - \bar{D}^*_{flex}/A^*)$.

But forming a monetary union also increases the borrowing capacity of foreign agents, as captured by the leftward shift of the I schedule for $\tilde{A} < A^*$. Now consider what happens if expectations coordinate on a capital flight equilibrium. Since the borrowing capacity of foreign agents is now higher, more capital flies out of the home country. If $G > (A - A^*)(N - \bar{D}^*_{mu}/A^*)$, the capital flight is large enough to push the after-tax return on home investment below A^*. Pessimistic expectations thus become self-fulfilling, and the capital flight indeed occurs. Forming a monetary union therefore creates the possibility of coordination failures in investment decisions. The following corollary to Proposition 4 collects these results.

Corollary 1 *Suppose that assumption 2 holds and that* $(A - A^*)(N - \bar{D}^*_{mu}/A^*) < G < (A - A^*)(N - \bar{D}^*_{flex}/A^*)$. *Then under flexible exchange rates the equilibrium is unique and features capital inflows. Instead, in a monetary union there is a stable capital inflows equilibrium and at least one stable capital flight equilibrium.*

In this example, the case in favor of forming a monetary union is not clear cut, and depends on expectations and animal spirits. If agents are optimistic, giving up exchange rate flexibility to join a monetary union leads to an increase in welfare, by fostering a more efficient allocation of capital across countries. However, in a monetary union self-fulfilling episodes of inefficient capital flights are possible. In particular, a wave of pessimism can induce capital flows toward the country characterized by the lowest productivity. When this happens, global production and welfare drop.

This example thus illustrates one of the potential dangers of forming a monetary union. The easiness with which capital can flow across countries in a monetary union, in fact, can generate financial instability and capital misallocation. Moreover, inefficient capital flights are more likely to happen when a monetary union is hit by large shocks requiring a fiscal response, such as during the ongoing Covid-19 pandemic. In this respect, the model suggests that participating in a common currency might hamper national governments' ability to react to shocks through fiscal policy. This is the case because, due to high capital mobility, a large increase in government expenditure creates the conditions for capital flights driven by pessimistic animal spirits.

5 Policy implications

A natural question to ask is whether there exist policy interventions that can rule out capital flight equilibria, so as to ensure that increasing financial integration by forming a monetary union leads to a rise in the union's welfare. I will now show that several policies can accomplish this objective. But I also argue that implementing them, due to their distributive implications, might require a high degree of international cooperation.

5.1 Capital controls and fiscal transfers

Let us start by considering capital controls. Suppose that the home government can impose a limit to lending abroad by home agents. During a capital flight, home investment is given by

$$I = N - \min\left(\frac{\bar{D}^*}{\tilde{A}}, \theta\right), \tag{14}$$

where θ denotes the upper limit on lending to foreign agents imposed by the home government. Effectively, by managing θ the government can impose a floor on investment in domestic capital. As illustrated by panel (a) of Figure 2, by setting θ low enough the government coordinates expectations on the capital inflow equilibrium.[27] Intuitively, capital flight equilibria are possible only if pessimistic expectations trigger large falls in domestic investment. Controls on capital outflows rule out capital flight equilibria, by reducing the sensitivity of investment to changes in expectations.

In practice, however, imposing controls on capital outflows might be challenging. The reason is that private agents have strong incentives to elude them. Ultimately, whether a government can successfully implement controls on outflows is an empirical question. While the jury is still out, existing evidence suggests that controlling capital outflows is a complicated task. For instance, Edwards (1999) summarizes the experience of emerging markets with controls on outflows, and concludes that they had a very limited impact on actual flows. Moreover, due to the complexity of their financial systems, successfully implementing controls on outflows in advanced economies might represent an even bigger challenge. In fact, Ilzetzki et al. (2019) document that controls on capital outflows have essentially been absent in advanced economies since the early 1990s.[28]

Alternatively, suppose that the foreign government were to impose a limit on capital inflows. Home investment during a capital flight would still be given by expression (14), with the caveat that θ now captures the limit on inflows imposed by the foreign government. By the logic outlined above, if θ is sufficiently low capital flight equilibria will be ruled out. Hence, a well-designed policy of controls on inflows can insulate capital flows from animal spirits. Again, however, there might be practical hurdles to the implementation of controls on inflows. For instance, the review of the empirical evidence by Ghosh et al. (2018) suggests that controls on inflows tend to have a small impact on the total quantity of flows.[29]

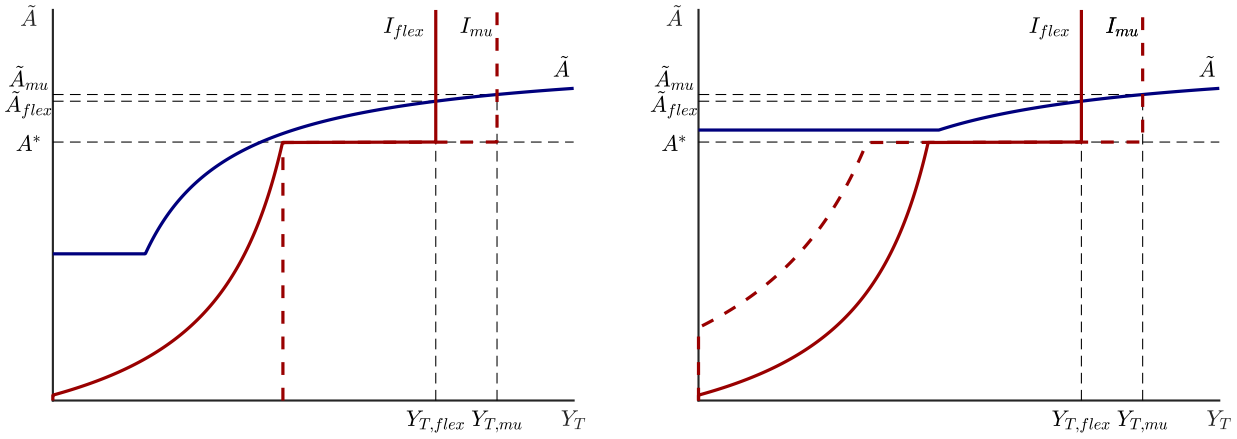
It is also possible to rule out capital flight equilibria through fiscal transfers. This resonates with the idea that monetary unions need to be complemented with fiscal solidarity (Kenen, 1969; Farhi and Werning, 2017). To see this point, suppose that in period 1 the foreign government makes a transfer T to the home government. The home government budget constraint then becomes

$$G = \tau Y_T + T.$$

[27] More precisely, in order to rule out capital flight equilibria θ must be such that $G < (A - A^*)(N - \theta)$.

[28] That said, recently controls on outflows have been imposed inside the euro area by Cyprus (Michaelides, 2014) and Greece. Moreover, Benediktsdottir et al. (2017) argue that in Iceland controls on outflows were successful in mitigating capital flights in the aftermath of the 2008 financial crisis.

[29] They also find that controls on inflows are successful at altering the composition of inflows.



(a) Capital controls. **(b) Fiscal transfers.**

Figure 2: Managing capital flows in a monetary union.

Let us also assume that the transfer is indexed to home production of tradable goods, according to the function $T = \max(G - \tilde{\tau} Y_T, 0)$. This policy effectively imposes an upper bound on the capital tax equal to $\tilde{\tau}$. As long as $A(1-\tilde{\tau}) > A^*$, capital flight equilibria will be ruled out. The reason is that, as shown by panel (b) of Figure 2, with this policy in place the return to investment at home will never fall below the foreign one.

So a system of sufficiently strong countercyclical transfers eliminates inefficient capital flights, by anchoring expectations on the good equilibrium in which capital flows toward high-productivity countries. This means that, as long as the transfer scheme is credible, inefficient capital flights are ruled out without the need to actually transfer resources across countries in equilibrium.

5.2 The importance of international cooperation

There is, however, a fundamental problem with the policies proposed above. The foreign government, in fact, has an incentive to oppose them. The reason is that capital flights out of the home country increase foreign citizens' welfare. This happens because capital flights depress the interest rate, allowing foreign agents to profit from the spread between the interest rate and the return to investment. More formally, under assumption 2, in a capital inflow equilibrium foreign agents' consumption of tradable goods is equal to A^*N^*. Instead, in a capital flight equilibrium foreign households tradable consumption is $A^*N^* + (A^*/\tilde{A} - 1)\bar{D}^* > A^*N^*$, since in a capital flight equilibrium $\tilde{A} < A^*$. Hence, from a global perspective implementing policies that rule out capital flight equilibria makes sense. But these policies have important redistributive implications, and so not all countries might support them.[30]

[30] Matters would be even more complex with within-country heterogeneity. For instance, imagine that foreign agents are split between productive agents and savers. The income of productive agents is increasing in investment in foreign capital, either because they directly own capital or because they supply some factor of production (for instance land or labor) whose return is increasing in the capital stock. Savers, instead, can only earn income by lending their savings on the credit markets. In this case, foreign productive agents would gain from an episode of

The general lesson here is that there are several policies that could rule out the negative side effects from the high degree of financial integration enjoyed by monetary unions. Implementing them, however, might be difficult due to their distributive implications. Indeed, during an episode of inefficient capital flights safe-haven countries - the foreign country in the example above - benefit from the inflows of cheap foreign capital. Safe-haven countries might then end up loosing from policies anchoring expectations on the equilibrium that maximizes global welfare. This result suggests that successfully managing financial integration in a monetary union requires close cooperation across member countries.

6 Conclusion

We have thus seen that forming a monetary union can lead to an increase financial integration across member countries. With a single currency, the reason is, national governments cannot use monetary policy to expropriate foreign investors. However, boosting financial integration by forming a monetary union might have an ambiguous impact on welfare. This happens because with high financial integration episodes of expectation-driven inefficient capital flights are possible, especially during periods of large asymmetric fiscal shocks, such as during the ongoing Covid-19 pandemic. While there are several policies that can eliminate pessimistic equilibria, most notably countercyclical fiscal transfers, their implementation requires international cooperation because of their redistributive implications.

This paper represents a first step of a larger research program connecting the exchange rate regime to financial integration. To conclude, let me mention two questions that could be addressed in future research. The first one is motivated by the fact that, in the run up to the 2008 global financial crisis, capital flows toward peripheral euro area countries were associated with a slowdown in productivity growth. Several explanations have been advanced by the literature. Benigno and Fornaro (2014) show that capital inflows might lead to lower productivity growth by discouraging innovation activities by firms in the tradable sector.[31] In Gopinath et al. (2017) and Reis (2013), instead, capital inflows depress productivity by inducing misallocation of capital across firms. This literature thus suggests that capital inflows might be detrimental to productivity growth. It would be interesting to revisit the benefits and costs from forming a currency union in light of this insight.

Second, in this paper I have focused on the impact of financial integration on *net capital flows* and on the international allocation of capital. International financial integration, however, also affects risk sharing across countries. In this respect, the model in this paper suggests that forming a currency union might facilitate international risk sharing, by increasing the potential for *gross capital flows* across member countries. Investigating the relationship between the exchange rate regime, gross capital flows and international risk sharing is a promising area for future research.

capital flight out of the home country. But savers would lose, because they would enjoy a lower return on their savings.

[31] See also Benigno et al. (2019) and Brunnermeier et al. (2018).

Appendix

A Proofs

A.1 Proof of Proposition 1

Proposition 1 *Under flexible exchange rates, default does not occur if and only if* $D \leq \bar{D}_{flex}$. *Moreover, in absence of default monetary policy sets* $p = Y_N = 1$. *Analogous expressions hold for the foreign country.*

Proof. The home government chooses p, Y_N and C_T to maximize home households' utility

$$C_T + \frac{Y_N^{1-\eta}}{1-\eta} - Y_N, \tag{A.1}$$

subject to

$$Y_N = p^{-\frac{1}{\eta}} \tag{A.2}$$

$$C_T = Y_T - \min\left[D, \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)\right]. \tag{A.3}$$

Substituting the constraints in the objective function, the government problem reduces to choosing p to maximize

$$Y_T - \min\left[D, \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)\right] + \frac{p^{1-\frac{1}{\eta}}}{1-\eta} - p^{-\frac{1}{\eta}}. \tag{A.4}$$

Let us start by assuming that $D \leq \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$, so that default does not occur. In this case, the objective function is maximized by setting

$$p = Y_N = 1 \equiv p_{nd}. \tag{A.5}$$

A necessary condition for this to be an equilibrium is $D \leq \kappa\left(Y_T + 1\right)$.

Now turn to the case $D > \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$, so that home households default. In this case, the objective function is maximized by setting

$$p = \left(1 + \kappa(\eta - 1)\right)^{-1} \equiv p_d. \tag{A.6}$$

A necessary condition for this to be an equilibrium is $D > \kappa\left(Y_T + \left(1 + \kappa(\eta-1)\right)^{\frac{1}{\eta}-1}\right)$.

The final step consists in finding the value of D for which default is avoided. Defaulting gives higher utility compared to repaying D whenever

$$Y_T - D + \frac{p_{nd}^{1-\frac{1}{\eta}}}{1-\eta} - p_{nd}^{-\frac{1}{\eta}} < Y_T - \kappa\left(Y_T + p_d^{1-\frac{1}{\eta}}\right) + \frac{p_d^{1-\frac{1}{\eta}}}{1-\eta} - p_d^{-\frac{1}{\eta}} \tag{A.7}$$

After a bit of algebra, the condition above can be written as

$$D > \kappa Y_T + \frac{\eta}{\eta - 1}\left[(1 + \kappa(\eta - 1))^{\frac{1}{\eta}} - 1\right] \equiv \bar{D}_{flex}. \tag{A.8}$$

One can show that $\kappa\left(Y_T + (1 + \kappa(\eta - 1))^{\frac{1}{\eta}-1}\right) < \bar{D}_{flex} < \kappa\left(Y_T + 1\right)$.[32] It follows that default is avoided if and only if $D \leq \bar{D}_{flex}$. The problem of the government in the foreign country is symmetric. ■

A.2 Proof of Proposition 2

Proposition 2 *In a monetary union, the home country does not default if and only if* $D \leq \bar{D}_{mu}$. *Moreover, monetary policy sets* $p = Y_N = 1$. *Analogous expressions hold for the foreign country.*

Proof. The central bank of the union chooses p, p^*, Y_N, Y_N^*, C_T, C_T^* to maximize households' utility

$$C_T + C_T^* + \frac{Y_N^{1-\eta}}{1-\eta} + \frac{Y_N^{*1-\eta}}{1-\eta} - Y_N - Y_N^*. \tag{A.9}$$

Since $Y_N = Y_N^*$ and $C_T + C_T^* = Y_T + Y_T^*$, the objective function can be written as

$$Y_T + Y_T^* + 2\left(\frac{Y_N^{1-\eta}}{1-\eta} - Y_N\right), \tag{A.10}$$

which is maximized subject to $Y^N = p^{\frac{1}{\eta}}$. The solution is $p = Y_N = 1$. The home country therefore does not default if and only if

$$D \leq \kappa\left(Y_T + 1\right) \equiv \bar{D}_{mu}. \tag{A.11}$$

Analogous expressions hold for the foreign country. ■

A.3 Proof of Proposition 3

Proposition 3 *Suppose that* $A > A^*$ *and that assumption 1 holds. Then moving from flexible exchange rates to a monetary union produces an increase in global output of tradable goods and welfare.*

[32] To prove the left part of the inequality, consider that it can be written as

$$\eta\left(x^{\frac{1}{\eta}} - 1\right) > \left(1 - \frac{1}{x}\right)x^{\frac{1}{\eta}},$$

where $x \equiv 1 + \kappa(\eta - 1) > 1$. Rearranging gives

$$x^{\frac{1}{\eta}}\left(\eta - 1 + \frac{1}{x}\right) > \eta.$$

To complete the proof, notice that the left-hand side is increasing in x for $x > 1$ and the expression holds as an equality if $x = 1$. To prove the right part of the inequality, consider that it can be written as

$$\eta x^{\frac{1}{\eta}} - x < \eta - 1.$$

To complete the proof, notice that the left-hand side is decreasing in x for $x > 1$ and the expression holds as an equality if $x = 1$.

Proof. Let us start by deriving the equilibrium under flexible exchange rates. Clearly it must be that $R \geq A^*$, otherwise demand for credit would exceed credit supply. Now suppose that $R > A^*$. Then it must be that all the funds are invested in the home country, but assumption 1 rule out this possibility. Then it must be that $R = A^*$ and, again by assumption 1, investment at home is given by

$$I = N + \frac{\bar{D}_{flex}}{A^*} < N + N^*. \tag{A.12}$$

Following the reasoning outlined above, in a monetary union it must be that

$$I = N + \min\left(\frac{\bar{D}_{mu}}{A^*}, N^*\right). \tag{A.13}$$

So output of tradable goods is higher in a monetary union compared to flexible exchange rates. Since production of non-traded goods does not depend on the exchange rate regime, welfare is higher in a monetary union compared to the case of flexible exchange rates. ■

A.4 Proof of Proposition 4

Proposition 4 *Suppose that the parameters satisfy the conditions stated by assumption 2. If* $G < (A - A^*)(N + \bar{D}/A^*)$ *there exists a unique stable capital inflows equilibrium in which home agents borrow up to the limit and maximize investment in domestic capital. If* $G > (A - A^*)(N - \bar{D}^*/A^*)$ *there exists at least one stable capital flight equilibrium in which home agents maximize lending to foreign agents. Therefore if* $(A - A^*)(N - \bar{D}^*/A^*) < G < (A - A^*)(N + \bar{D}/A^*)$ *there are multiple stable equilibria. If multiple equilibria are possible, global output and welfare are higher in the capital inflow equilibrium compared to the capital flight equilibria.*

Proof. To prove the first part of the proposition, imagine that a capital inflows equilibrium exists. In a capital inflows equilibrium the after-tax return on home investment is higher than the interest rate. Let us guess that in this equilibrium the interest rate is equal to A^*. Since home agents maximize investment in domestic capital they borrow up to the limit and so

$$I = N + \frac{\bar{D}}{A^*} < N + N^*,$$

where the inequality follows from assumption (12) and the fact that $\bar{D}_{flex} < \bar{D}_{mu}$. The tax rate is then equal to

$$\tau = \min\left(\frac{G}{A\left(N + \frac{\bar{D}}{A^*}\right)}, \bar{\tau}\right).$$

Condition $G < (A - A^*)(N + \bar{D}/A^*)$ ensures that $\tilde{A} > A^*$. This proves that a capital inflow equilibrium exists. To see why this equilibrium is stable, imagine that there was a slight fall in aggregate investment in domestic capital. The after-tax return to investing at home would still be higher than the interest rate, meaning that home agents would have an incentive to increase investment until the initial equilibrium is restored. We do not need to consider upward movements

in aggregate investment, since the borrowing constraint rules them out.

To prove the second part of the proposition, imagine that a capital flight equilibrium exists. In a capital flight equilibrium $\tilde{A} < A^*$. Let us guess that in this equilibrium investment in home capital is positive, and so the interest rate is equal to $\tilde{A}$. Since home agents maximize lending to foreign agents, investment in foreign capital will be equal to

$$I^* = N^* + \frac{\bar{D}^*}{\tilde{A}} < N + N^*,$$

where the inequality follows from assumption (13) and the fact that $\bar{D}^*_{flex} < \bar{D}^*_{mu}$ and $\tau \leq \bar{\tau}$. The tax rate is then equal to

$$\tau = \min\left(\frac{G}{A\left(N - \frac{\bar{D}^*}{\tilde{A}}\right)}, \bar{\tau}\right).$$

Condition $G > (A - A^*)(N - \bar{D}^*/A^*)$ then ensures that $\tilde{A} < A^*$. This proves that a capital flight equilibrium exists. To prove that this equilibrium is stable, consider a slight fall in aggregate investment at home. This triggers an increase in taxes and a drop in the interest rate. In turn, the drop in the interest rate increases borrowing from foreign agents leading to an increase in capital flights and a fall in home investment. The equilibrium is stable if the fall in investment drive by capital flight is smaller than the initial deviation. A symmetric argument holds for upward deviations. Therefore, an equilibrium is stable if around the equilibrium point the $A(1-\tau)$ schedule is flatter than the I schedule. Looking at Figure 1 one can see that if a capital flight equilibrium exists, there is always going to be a capital flight equilibrium that satisfies this property.

The third part of the proposition follows from the fact that $(A - A^*)(N - \bar{D}^*/A^*) < (A - A^*)(N + \bar{D}/A^*)$. Finally, If multiple equilibria are possible the capital inflow equilibrium will feature the highest investment in home capital. Then the capital inflow equilibrium will also be the one with the highest global production of tradable goods. Since global production of non-tradables is the same across all the equilibria, the capital inflow equilibrium will also be the one with the highest global welfare. ■

B Multiple equilibria with technological spillovers

In this Appendix I consider a scenario in which coordination failures can happen due to the presence of technological spillovers. This is the case in the classic contributions by Bryant (1987) and Murphy et al. (1989). In these frameworks, agents can invest in two technologies, one of which is characterized by a higher return. However, investing in the high-return technology is profitable only if enough agents do so. Agents can thus coordinate on an optimistic equilibrium, in which everybody ends up adopting the high-return technology. But expectations can also coordinate on a pessimistic equilibrium, in which every agent remains stuck with the low-return inefficient technology.

To capture this idea, assume that the return on home capital depends on aggregate domestic

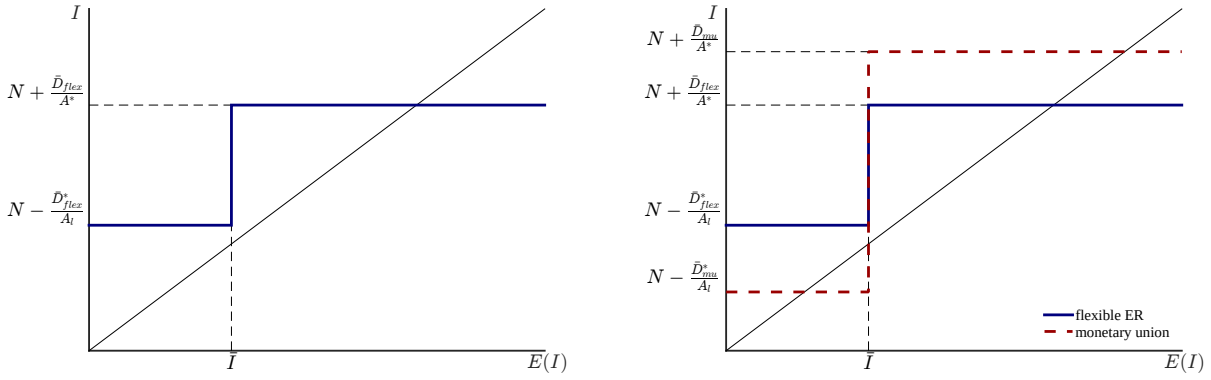


Figure 3: Equilibrium with aggregate increasing returns from investment. Notes: left panel refers to flexible exchange rates, right panel shows impact of creating a monetary union.

investment

$$A = \begin{cases} A_l & \text{if } I < \bar{I} \\ A_h & \text{if } I \geq \bar{I}. \end{cases} \tag{B.1}$$

In words, the return to investing in domestic capital experiences an upward jump once the threshold level of aggregate investment ($\bar{I}$) is reached. This is the case if switching from a low-return to a high-return technology entails positive spillovers across agents, so that the high-return technology is profitable only if it is adopted on a large-enough scale. For simplicity, assume that the return from investing in foreign capital is constant and equal to A^*. Moreover, to make things interesting, consider the case $A_l < A^* < A_h$. Hence, investing in the home economy is efficient only if the threshold level of investment $\bar{I}$ is reached.

Individual investment decisions now depend on expectations of aggregate investment. In particular, if agents expect that $I \geq \bar{I}$ they anticipate that capital will yield a higher return in the home country compared to the foreign one. It will then be optimal for home households to maximize investment in domestic capital by borrowing up to the limit. Conversely, if agents expect that $I < \bar{I}$ it will be optimal for home agents to minimize investment in domestic capital by shipping as much capital as possible abroad.

Rather than fully characterizing all the possible equilibria of this version of the model, let me provide an example in which forming a monetary union reduces welfare. Again, restrict attention to equilibria in which the borrowing limit is always binding.[33] Now consider a case in which the equilibrium under flexible exchange rates is as depicted in the left panel of Figure 3.

Figure 3 plots actual investment I as a function of expected investment $E(I)$. If $E(I) \geq \bar{I}$ then it is more profitable to invest in home rather than in foreign capital. In this case, home agents borrow up to the limit to maximize investment in domestic capital. The equilibrium interest rate is $R = A^*$, so that foreign agents are indifferent between investing in foreign capital or lending to home agents. If instead $E(I) < \bar{I}$, it is foreigners who will maximize borrowing from domestic

[33] This requires that N and N^* are sufficiently large.

agents to invest in foreign capital. The borrowing capacity of foreign agents, however, is not large enough to fully absorb savings from home households, and so there is positive investment in home capital. The equilibrium interest rate is then $R = A_l$, so that home agents are indifferent between investing in capital or on the credit market.

In the case shown in the figure, the only possible equilibrium is one in which investment in home-country capital is large enough so that the high-return technology is adopted. It is useful to pause for a second and consider why the pessimistic equilibrium, in which the low-return technology is adopted, is ruled out. Imagine that agents anticipate that the low-return technology will be adopted. In this case, home agents will ship capital abroad until the borrowing constraint of foreign households ends up binding. But, in the case shown in the figure, the borrowing limit of foreign agents is so tight that investment in home capital exceeds the threshold $\bar{I}$ even if expectations coordinate on the pessimistic equilibrium. For this reason, under flexible exchange rates the pessimistic equilibrium cannot materialize.

The right panel illustrates what may happen once a monetary union is formed. Domestic agents can now sustain a higher amount of foreign debt. Hence, if the high-return technology is adopted home agents increase their foreign borrowing and more capital is be installed in the home country. Graphically, this is captured by the upward shift in the investment curve for the range $E(I) \geq \bar{I}$. Therefore, if expectations coordinate on the optimistic equilibrium the efficiency in the international allocation of capital is higher in a monetary union compared to the case of flexible exchange rates.

But now consider what happens if agents expect that the low-return technology is adopted. Since the borrowing capacity of foreign agents is now higher, more capital flies out of the home country compared to the case of flexible exchange rates. In the case shown in the figure, this capital flight is large enough so that investment in home capital is lower than the threshold $\bar{I}$. Hence, the low-return technology ends up being adopted, validating agents' initial pessimistic expectations. Forming a monetary union thus creates the possibility of coordination failures in investment decisions.[34]

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[34]There are some similarities with the results highlighted by Bryant (1987). In Bryant's model agents can invest in capital, which is characterized by increasing aggregate returns, and cash, which offers a fixed return. The option to invest in cash makes it possible for agents to coordinate on pessimistic equilibria in which the increasing returns from investing in capital are not exploited. The key difference is that in the model of this paper the exchange rate regime determines the extent to which agents can divert their savings away from investment in domestic capital, and thus whether multiple equilibria are possible.

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