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GLOBAL IMBALANCES, EXCHANGE RATE PEGS AND CAPITAL FLOWS: A CLOSER LOOK

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ABSTRACT/RESUMÉ

Global imbalances, exchange rate pegs and capital flows: a closer look

This paper presents a stylised model in which either a savings glut or an exchange rate peg in emerging economies drives down the level of interest rates in advanced economies and, when it hits the zero-rate bound, produces a welfare loss. It shows that structural reform in the pursuit of better social protection and financial markets in the emerging economies reduces this negative welfare spillover. An extension of the model with the short-run dynamics of exchange-rate and capital movements shows that adverse asymmetric shocks can lead to a race to the bottom of interest rates. In that case the global coordination of monetary policies is welfare enhancing for both groups of economies. However, the coordinated equilibrium is unstable, which indicates that strong pre-commitment arrangements are required to maintain coordination. This disadvantage diminishes if structural reform is adopted to reduce the volatility in capital flows.

JEL classification codes: E52, F31, F59.

Key words: exchange rates; global imbalances; capital flows.

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Les déséquilibres mondiaux, l'arrimage des taux de changes et les mouvements de capitaux : examen à la loupe

Ce document présente un modèle simplifié dans lequel une surabondance de l'épargne ou un mécanisme d'arrimage des taux de change dans des économies émergentes fait baisser le niveau des taux d'intérêt dans les économies avancées et aboutit, lorsque l'on se heurte à la limite des taux nuls, à une perte de bien-être. Il montre que les réformes structurelles visant à améliorer la protection sociale et les marchés de capitaux dans les économies émergentes réduisent ces retombées négatives sur le bien-être. Un élargissement du modèle tenant compte de la dynamique de court terme des taux de change et des mouvements de capitaux montre que des chocs asymétriques négatifs peuvent déboucher sur une surenchère à la baisse des taux d'intérêt. Dans ce cas, une coordination mondiale des politiques monétaires améliore le bien-être des deux groupes d'économies. Toutefois, l'équilibre résultant de cette coordination est instable, ce qui indique la nécessité de solides engagements préalables visant à maintenir la coordination. Ce désavantage diminue en cas d'adoption de réformes structurelles permettant de réduire la volatilité des mouvements de capitaux.

Classification JEL : E52, F31, F59.

Mots-clés : taux de change ; déséquilibres mondiaux ; flux des capitaux.

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By Paul van den Noord[1]

Introduction

In a recent IMF policy staff discussion note Blanchard and Milesi-Feretti (2011, hereafter BM) present a simple stylized model to underpin some of their messages regarding the need to reign in global imbalances. Specifically, the model illustrates neatly that if part of the world economy is in a liquidity trap, smaller current account surpluses in surplus countries might benefit growth and welfare in the rest of the world.

This short paper serves two main purposes. First, it aims to replicate BM's findings using a formal version of their model (they use graphics), so as to deepen the understanding of its workings. Second, it aims to explore possible extensions so as to capture a number of current policy issues. It will explore two cases: (i) the case of the surplus country (i.e. China) maintaining an outright exchange rate target and capital controls; and (ii) the case of deficit and surplus countries being exposed to financial stability risk associated with excessive capital flows and major swings in their exchange rate.

The baseline model

BM consider the following two-country model. Demand for domestic output Y in the home country is a function of its real exchange rate e (negatively signed) and of the (real) interest rate r (id.). An analogous condition holds in the foreign country, where instead an appreciation in the home country is associated with higher output. The model is log-linearized to facilitate the analytical solution:

$$Y = -\phi_1 e - \phi_2 r + \mu \tag{1}$$
$$Y^* = \phi_1^* e - \phi_2^* r^* + \mu^* \tag{2}$$

An asterisk denotes the foreign country and μ is an exogenous demand shock term (which may include fiscal policy). BM assume perfect capital mobility, so domestic and foreign interest rates must be equal (aside from a risk premium which is set to zero for convenience):

$$r = r^* \tag{3}$$

Both countries minimize a loss function which is a function of the difference between output and an output target:

$$\min_{r} L = \frac{1}{2}\left(Y - \overline{Y}\right)^2 \tag{4}$$

$$\min_{r^*} L^* = \frac{1}{2}\left(Y^* - \overline{Y}^*\right)^2 \tag{5}$$

The first order conditions read:

$$r = \frac{-\phi_1 e - \overline{Y} + \mu}{\phi_2}; \; Y = \overline{Y} \tag{6}$$

$$r^* = \frac{\phi_1^* e - \overline{Y}^* + \mu^*}{\phi_2^*}; \; Y^* = \overline{Y}^* \tag{7}$$

Respecting equality (3) yields the following solution for the exchange rate:

$$e = \frac{\phi_2\left(\overline{Y}^* - \mu^*\right) - \phi_2^*\left(\overline{Y} - \mu\right)}{\phi_1^* \phi_2 + \phi_1 \phi_2^*} \tag{8}$$

As depicted in the left panel of Figure 1, BM's conclusion that an increase in saving in the foreign country (i.e. a negative demand shock $\mu^* < 0$) would yield an appreciation of the exchange rate of the home country is correct. The home country can offset this by a cut in the interest rate so that it can still achieve its output target (see equation (6)). There is no welfare loss. But there is a negative impact on the home country's interest rate. Importantly, this supports the "savings glut" explanation of the interest rate "conundrum" (Bernanke 2005, Bernanke et al. 2011).

Things change when the home country no longer disposes of its interest rate instrument because it is at the zero rate bound ($r=0$, see the right panel of Figure 1). The solution for the exchange rate now reads:

$$e = \frac{\overline{Y}^* - \mu^*}{\phi_1^*} \tag{9}$$

And output in the home country equals:

$$Y = -\phi_1 \frac{\overline{Y}^* - \mu^*}{\phi_1^*} + \mu < \overline{Y} \tag{10}$$

This implies that the home country suffers an output (and welfare) loss if the foreign country experiences a negative demand shock (i.e. an increase in saving). This is in line with BMs conclusion. As BM implicitly suggest, the only way the home country can escape this loss is by generating an offsetting positive demand shock, i.e. an expansionary fiscal policy. But as BM note, this strategy will run into fiscal sustainability problems. Alternatively, it can try to persuade the foreign country to reduce its saving rate by reforming its economy – which may be needed anyway to sustain long-run economic growth and to achieve social goals. For example, the foreign country could improve its systems for risk sharing (social security, insurance markets) so as to remove incentives for excessive household saving. Or it could develop its judicial system to better enforce property rights as this would facilitate the use of collateral for bank credit (and thus reduce its cost).

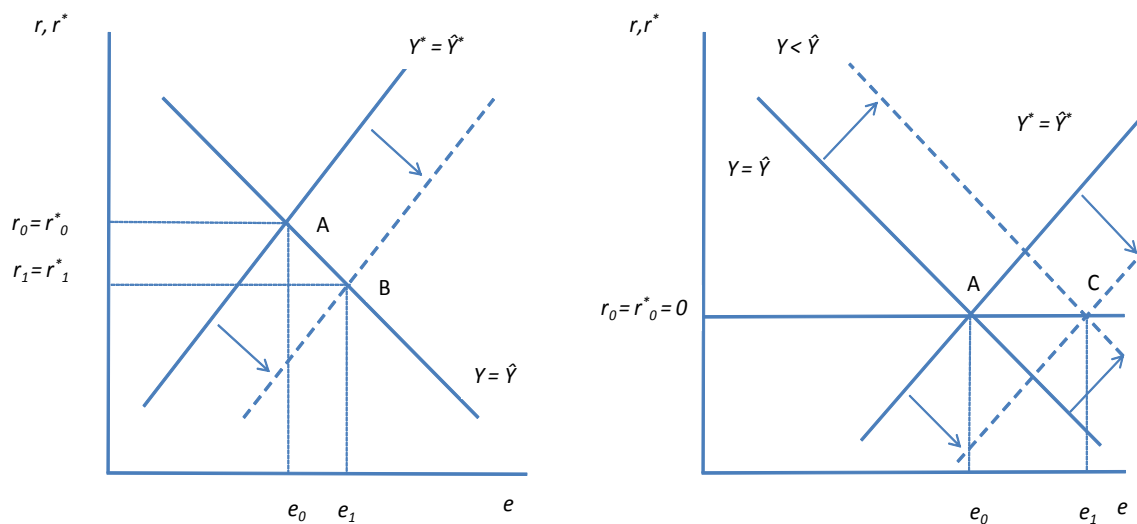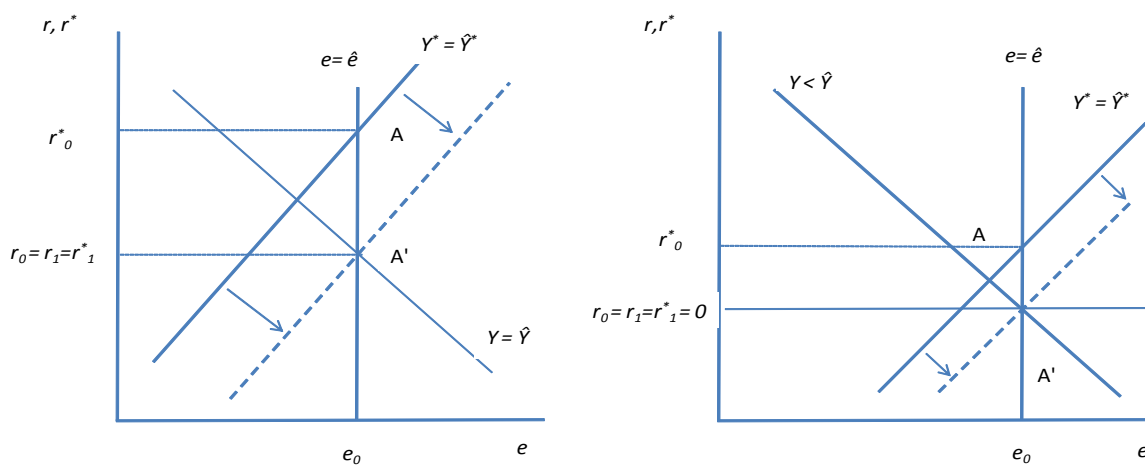**Figure 1. Saving glut with flexible exchange rates**

Figure 2. Saving glut with fixed exchange rates

The surplus country pegs its exchange rate

While BM's model is a reasonable way of describing the current relationship between the United States and many emerging economies, it does not hold for its relationship with China, for two important reasons. First, the foreign country is assumed to pick its exchange rate as a function of the strength of its domestic demand (saving), but this is out of line with the Chinese policy framework, which is rather operating an exchange rate target *tout court*. Second, the assumption of perfect capital mobility may not hold given that China maintains capital controls. We therefore reformulate the model as follows.

First, adding an exchange rate target for the foreign country modifies the loss function to:

$$\min_{r^*, e} L^* = \frac{1}{2}\left(Y^* - \bar{Y}^*\right)^2 + \beta^* \frac{1}{2}\left(e - \bar{e}\right)^2 \tag{5a}$$

Second, we drop condition (3) of interest rate arbitraging. The first order conditions now read:

$$r = \frac{-\phi_1 \bar{e} - \bar{Y} + \mu}{\phi_2}; \ Y = \bar{Y} \tag{6a}$$

$$r^* = \frac{\phi_1^* \bar{e} - \bar{Y}^* + \mu^*}{\phi_2^*}; \quad e = \bar{e}; \ Y^* = \bar{Y}^* \tag{7a}$$

This means that the two countries no longer maintain the same interest rate. A yield spread of the foreign country against the home country opens up (see the left panel of Figure 2). It corresponds to the cost of sterilized intervention in the foreign country (r is the interest rate earned on foreign reserves and r^* is the interest rate paid on deposits of the banking system with the central bank).

If the foreign country experiences an increase in saving ($\mu^* < 0$, see again the left panel of Figure 2), it will cut its interest rate, perhaps eliminate the yield spread (as assumed in Figure 2), but there will be no spillover effects onto the interest rate of the home country. Importantly, this finding invalidates the savings glut hypothesis since saving in the foreign country exerts no influence on the interest rate in the home country! Even so, the home country will run a lower interest rate than in the BM model, even in the absence of a savings glut from the foreign country. This is because the home country needs to offset its higher exchange rate by running a lower interest rate so as to achieve its output target. So it is the pegged exchange rate rather than the savings glut that drives the interest rate down in the home country.

It is interesting to examine what happens if we re-introduce the zero-rate bound in the home country (see the right panel of Figure 2). Output in the home country is now determined as:

$$Y = -\phi_1 \bar{e} + \mu < \bar{Y}; \qquad e = \bar{e} \tag{10a}$$

This outcome is independent of the savings propensity in the foreign country. The exchange rate policy of the foreign country, but not its savings propensity, has an adverse impact on the home country's output and welfare.

Conclusion: it is not the Chinese savings glut that generates a welfare loss in the US, but it is the Chinese exchange rate policy that does so! The implications are clear-cut. The home country is likely to exert pressure on the foreign country to abandon its exchange rate policy and capital controls. But this

brings us back to square one: the BM model again applies and the welfare loss remains. Therefore, dropping the exchange rate peg and opening the capital account in the foreign country will only have the hoped-for welfare-enhancing effect on the home country if it is combined with structural reform of the kind discussed in the previous section.

Capital flows and exchange rate swings

Next, it may be useful to go back to the baseline version of the model since it does describe correctly the situation for the relationship between the United States and most surplus countries other than China -- and as we have seen it would also apply to China once it has abandoned its exchange rate peg and capital controls. However, the analysis can be enriched by looking not only at the long-run solution, but also at the short-run dynamics. In the long run the interest rate spread is arbitraged away, but it does take time for this to happen. If the foreign country's yield gap is positive, i.e. the home country is running an easier monetary policy than the foreign country, this will prompt capital flows from the home to the foreign country, which drives the foreign country's exchange rate up. This may give rise to a "currency war".

This can be very simply modeled by adding an exchange rate equation to the baseline model:

$$\Delta e \equiv e - e_{-1} = \chi\left(r - r^*\right) \tag{3b}$$

Note that in long-run equilibrium $\Delta e = 0$ and hence $r = r^*$, which gives us back the baseline model. The loss functions now read:

$$\min_{r} L = \frac{1}{2}\left(Y - \overline{Y}\right)^2 + \beta\frac{1}{2}\left(e - e_{-1}\right)^2 \tag{4b}$$

$$\min_{r^*} L^* = \frac{1}{2}\left(Y^* - \overline{Y}^*\right)^2 + \beta^*\frac{1}{2}\left(e - e_{-1}\right)^2 \tag{5b}$$

So both countries trade their output target against the objective of stability of their exchange rate. Exchange rate volatility may pose political costs. Increased uncertainty for exporters and foreign investors may put pressure on policymakers to adjust policy. In addition, the capital flows that drive the exchange rate up (or down) themselves may increase financial stability risks (bubble formation, sudden stops, banking crisis, etc.) in the future. Hence, in some sense, the parameter β may be interpreted to depend on the rate of time preference of policymakers.

In this model countries interact with each other and play a Nash game. The Nash solution can be found by solving the first order conditions for a minimum loss, which yields reaction functions for each country's monetary policy:

$$r = \frac{\left(\phi_1\chi + \phi_2\right)\left(-\phi_1 e_{-1} + \mu - \overline{Y}\right)}{\left(\phi_1\chi + \phi_2\right)^2 + \beta\chi^2} + \frac{\left(\phi_1\chi + \phi_2\right)^2 + \beta\chi^2 - \left(\phi_1\chi + \phi_2\right)\phi_2}{\left(\phi_1\chi + \phi_2\right)^2 + \beta\chi^2}r^* \tag{11}$$

$$r^* = \frac{\left(\phi_1^*\chi + \phi_2^*\right)\left(\phi_1^* e_{-1} + \mu^* - \overline{Y}^*\right)}{\left(\phi_1^*\chi + \phi_2^*\right)^2 + \beta^*\chi^2} + \frac{\left(\phi_1^*\chi + \phi_2^*\right)^2 + \beta^*\chi^2 - \left(\phi_1^*\chi + \phi_2^*\right)\phi_2^*}{\left(\phi_1^*\chi + \phi_2^*\right)^2 + \beta^*\chi^2}r \tag{12}$$

So, if one country cuts its interest rate, the other will follow suit, etc. in a race to the bottom. This may produce a welfare loss for both, as demonstrated below. Coordination may thus pay off.

The coordinated solution can be found by minimizing the combined loss function:

$$\min_{r,r*} \tilde{L} = \frac{1}{2}\left(Y - \bar{Y}\right)^2 + \frac{1}{2}\left(Y^* - \bar{Y}^*\right)^2 + \left(\beta + \beta^*\right)\frac{1}{2}\left(e - e_{-1}\right)^2 \tag{13}$$

This yields the following interest rate relationships:

$$r = \frac{\left(\phi_1\chi + \phi_2\right)\left(-\phi_1 e_{-1} + \mu - \bar{Y}\right) + \phi_1^*\chi\left(-\phi_1^* e_{-1} - \mu^* + \bar{Y}^*\right)}{\Omega} + \frac{\Omega + \left(\phi_1^*\phi_2^* - \phi_1\phi_2\right)\chi - \phi_2^2}{\Omega} r^* \tag{14}$$

$$\Omega = \left(\phi_1\chi + \phi_2\right)^2 + \left(\beta + \beta^*\right)\chi^2 + \phi_1^{*2}\chi^2$$

$$r^* = \frac{\left(\phi_1^*\chi + \phi_2^*\right)\left(\phi_1^* e_{-1} + \mu^* - \bar{Y}^*\right) + \phi_1\chi\left(\phi_1 e_{-1} - \mu + \bar{Y}\right)}{\Omega^*} + \frac{\Omega^* + \left(\phi_1\phi_2 - \phi_1^*\phi_2^*\right)\chi - \phi_2^{*2}}{\Omega^*} r \tag{15}$$

$$\Omega^* = \left(\phi_1^*\chi + \phi_2^*\right)^2 + \left(\beta + \beta^*\right)\chi^2 + \phi_1^2\chi^2$$

It is rather cumbersome to compute the analytical solution, so we will revert to a numerical solution. The elasticities of output with respect to the exchange and interest rate are calibrated on the ready-reckoner tables emerging from the OECD's Global Model (Hervé *et al.* 2010). Accordingly, for the home country the parameter ϕ_1 is set at 0.1 and the parameter ϕ_2 at 0.5 (this roughly corresponds to the second year effect in the United States model). For the short-run impact of interest rates on the exchange rate represented by the parameter χ a value of 1.5 is adopted in line with findings by Kearns and Manner (2006). The weight of (future) financial instability risk associated with capital inflows in the welfare loss function β is hard to determine empirically, but it is plausible that this must be in the range $0 < \beta < 1$, i.e. its weight is non-zero, but smaller than the weight of current output. For convenience a baseline value of 0.5 is adopted. To maintain baseline symmetry between the two economies the same parameter values are adopted for the foreign country. The other assumed baseline parameter values are $e_{-1} = \bar{Y} = \bar{Y}^* = 0; \mu = \mu^* = 2$.

It is now possible to compute the payoff matrix gauging the welfare effects of four scenarios: both countries cooperate; both countries defect; the home country defects; and the foreign country defects.

Without asymmetric shocks the payoff matrix reads (e^* is the inverse of e):

Home	Foreign Defects		Foreign Coops			Home	Foreign Defects		Foreign Coops	
	Y	Y*	Y	Y*			L	L*	L	L*
Defects	0.00	0.00	0.00	0.00		Defects	0.00	0.00	0.00	0.00
Coops	0.00	0.00	0.00	0.00		Coops	0.00	0.00	0.00	0.00

Home	Foreign Defects		Foreign Coops			Home	Foreign Defects		Foreign Coops	
	r	r*	r	r*			e	e*	e	e*
Defects	4.00	4.00	4.00	4.00		Defects	0.00	0.00	0.00	0.00
Coops	4.00	4.00	4.00	4.00		Coops	0.00	0.00	0.00	0.00

So the interest rate is the same in both countries (4% in this case), and there is no welfare loss in either scenario.

An interesting case to examine is when the home country is hit by an adverse demand shock ($\Delta\mu$=-1) and therefore eases its monetary policy. This will set in motion a capital flow to the foreign country and drive up its exchange rate. The latter will respond by cutting its interest rate to undo some of the exchange rate hike. The home country will then again cut its interest rate, etc. This race to the bottom will stop when a new equilibrium is reached.

The interesting question is if there are welfare gains to be reaped from the coordination of monetary policies of the two countries. The payoff matrix below suggests that this is indeed the case.

	Foreign						Foreign			
	Defects		Coops				Defects		Coops	
Home	Y	Y*	Y	Y*		Home	L	L*	L	L*
Defects	-0.41	0.48	-0.31	0.60		Defects	0.23	0.29	0.13	0.40
Coops	-0.55	0.36	-0.44	0.49		Coops	0.34	0.17	0.22	0.26

	Foreign						Foreign			
	Defects		Coops				Defects		Coops	
Home	r	r*	r	r*		Home	e	e*	e	e*
Defects	2.88	3.12	2.67	2.85		Defects	-0.35	0.35	-0.27	0.27
Coops	3.15	3.33	2.92	3.07		Coops	-0.27	0.27	-0.23	0.23

The result is that in the Nash solution (both defect) the home economy maintains an undervalued exchange rate, as is to be expected. The home country fails to achieve its output target while the foreign country moves beyond this target. Hence the foreign economy is likely to overheat, although we cannot be absolutely sure since we have not modelled the supply side of the economy (a possible extension of the model).

The coordinated equilibrium is an international monetary system in which exchange rates float but where monetary policy is coordinated. It results in a rebalancing of the exchange rate relative to the Nash equilibrium and a smaller interest rate spread, which is Pareto superior to the Nash solution. However, in the coordinated equilibrium each player can raise welfare by defecting, so both will defect like in the game of chicken. Hence, while the Nash equilibrium is stable, the coordinated equilibrium is not. This indicates that strong pre-commitment arrangements are required to maintain the coordinated equilibrium.

Is there any role for structural policy here? In fact there is. If both countries reform their economies so as to make them more resilient to exchange rate risk and capital flows (in or out), the risk of exchange rate overshoots falls and the associated welfare loss will fall as well (see the payoff matrix below for the case $\chi = 0.75$). However, the constellation of an unstable coordinated and stable Nash equilibrium remains. Only at the limit ($\chi = 0$) the risk effect vanishes.

	Foreign						Foreign			
	Defects		Coops				Defects		Coops	
Home	Y	Y*	Y	Y*		Home	L	L*	L	L*
Defects	-0.30	0.39	-0.24	0.52		Defects	0.20	0.26	0.12	0.34
Coops	-0.45	0.31	-0.36	0.43		Coops	0.26	0.16	0.18	0.23

	Foreign						Foreign			
	Defects		Coops				Defects		Coops	
Home	r	r*	r	r*		Home	e	e*	e	e*
Defects	2.69	3.31	2.55	3.04		Defects	-0.46	0.46	-0.37	0.37
Coops	2.96	3.45	2.79	3.21		Coops	-0.37	0.37	-0.32	0.32

Conclusion

The model by Blanchard and Milesi-Feretti (2011) does a good job in explaining how a "savings glut" in China may either drive down the interest rate in the United States (the interest rate conundrum) or lead to a welfare loss in the United States when the latter is in a liquidity trap. The reason for the latter situation is that US cannot cut its interest rate to offset an increase in its exchange rate in response to weak (import) demand in China.

A version of the model in which China pegs its exchange rate, shows that it is not the savings glut per se, but rather the exchange rate peg that drives down US interest rates and, when it hits the zero-rate bound, produces a welfare loss. The policy implications are similar though. In both cases, structural reform in China in the pursuit of better social protection and financial markets has positive welfare spillovers on the United States. Importantly, this result can probably be generalised to all emerging surplus and advanced deficit economies.

An extension of the model with the short-run dynamics of exchange-rate and capital movements shows that adverse asymmetric shocks can lead to a race to the bottom of interest rates. In that case coordination of monetary policies is welfare enhancing. However, the coordinated equilibrium is unstable, which indicates that strong pre-commitment arrangements are required to maintain coordination. This disadvantage diminishes if both countries reform their economies so as to make them more resilient to exchange rate risk and capital flows.

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