Ensuring a Competitive and Stable Real Exchange Rate:  
A Macroeconomic Policy Strategy  

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Oil exporting countries tend to have strong real and volatile real exchange rates that conspire against their ability to diversify the economy. Real exchange rate appreciation and its associated Dutch Disease have received ample attention. Less well known is the fact that a recurring feature of oil exporting economies has been a real exchange rate cycle associated with the ups and downs of oil revenues. In a sample of 75 industrial and developing countries, some oil and gas producers, notably Nigeria, Bolivia, Ecuador and Venezuela have among the highest levels of longer term real exchange rate volatility (Figure 1). Interestingly, oil-exporting Norway appears with the lowest volatility.

Understanding the determinants of the real exchange rate: the concavity of the production possibility frontier

It has been common to assume that an improvement in the terms of trade necessarily leads to real appreciation. However, it is important to understand what lies behind this connection. To shed some light on this issue, we will start with a benchmark model in which this is not the case.

Assume that both tradables and non-tradables are produced with capital and labor with a constant-returns-to-scale (CRS) technology. Assume further that capital is perfectly mobile internationally. Obviously, this assumption implies that this benchmark should be considered relevant only for the medium term, when capital has had the time to adjust to the level that would equalize domestic and international returns. Under these assumptions the real exchange rate is not affected by shifts in demand because the supply of non-tradables is infinitely elastic and the Production Possibilities Frontier (PPF) is flat. An increase in the demand for non-tradables would be accommodated by getting more workers from the tradable sector and more capital from abroad. Since the technology is CRS, this implies no increase in marginal costs and hence in relative price. The economy adjusts through changes in the composition of output without changes in relative prices: the real exchange rate does not move!

In this medium-term framework, the real exchange rate should move very little unless there are large differential technology shifts between tradables and non-tradables, which would shift the slope of the PPF. Shocks to the terms of trade would not affect the real exchange rate, only the composition of output.

The idea that shocks to the terms of trade leads to real appreciation is predicated on the idea that factors of production – international capital and domestic labor in this case – move slowly to adjust to shocks. However, in this case, fluctuations of the RER would be temporary and the RER would return to its long-run equilibrium level once the adjustment has taken place, independently of the terms of trade.
But even at 5 year horizons, the real exchange rate of oil exporting countries is very volatile, even by the standards of developing countries as shown in Figure 1. The obvious question is what is missing from the benchmark model that can account for this low-frequency volatility? One element would be fixed factors. If besides capital (which can be moved and accumulated) and labor there is another factor whose supply is fixed or quasi-fixed, such as land, air, fresh water, etc., this will make the PPF concave. Movements along the PPF now require changes in the RER. An increase in the production of non-tradables will require an appreciation of the real exchange rate (RER). In addition, changes in the RER will not only shift production, but also affect the composition of demand: a real appreciation will shift demand away from non-tradables, thus facilitating the return to balance in the market for non-tradables.

Data shows that developing countries have on average an RER which is about 2.5 times more volatile than that of industrial countries. Shocks to this volatility are also much more persistent (Hausmann, Panizza and Rigobon, 2004a). The cause of this is still unclear. Obviously, the greater reliance on natural resources might explain the presence of decreasing returns and hence a more concave PPF. However, since natural-resource-intensive sectors such as oil and gas tend to be capital intensive and tradable, while generating little employment, it is unlikely that they would create much concavity in the aggregate PPF.

An alternative hypothesis is that something makes capital less mobile in developing countries. Hausmann, Panizza and Rigobon (2004b) propose such a model. They assume that there is some financial or investment imperfection that causes investors to behave as if they were more risk averse. The idea is predicated on the notion that in a world of complete markets, risk-averse individuals would behave as if they were risk neutral because they would be able to hedge any undesired risk. They conjecture is that the more incomplete the market, the more behavior will be characterized by risk aversion.

This assumption introduces an interesting and perverse dynamic. The more volatile the RER, the riskier it is to invest, especially in tradables. If there is risk aversion, this will imply a higher required expected return and a lower level of investment in tradables. This makes the economy more closed and less diversified.

Now, most open-economy macro models have the property that the more closed the economy, i.e. the smaller the tradable sector, the bigger the required shift in the RER for any given shock (Calvo, Izquierdo and Talvi, 2003). These two forces constitute a positive feedback or multiplier which may trap the economy in a vicious circle in which the RER is volatile because the economy is closed, but the economy is closed because the volatility in the RER makes it too risky to invest in non-oil tradables. In a dynamic setting this makes the stock of capital less responsive to real shocks and consequently the real exchange rate must do more of the adjustment, meaning that it needs to be more volatile.

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1 Profits in tradables are more sensitive to real exchange rate fluctuations because RER appreciations (depreciations) imply a falling (rising) relative price of tradables but are often accompanied by rising (falling) wages. Since prices and costs move in opposite directions this increases the instability in profits. By contrast, in the non-tradable sector there tends to be a positive correlation between prices and wages, thus stabilizing profits. A sufficient condition for this to hold is that the tradable sector be more capital intensive than the non-tradable sector.
Hence, the volatility of the real exchange rate in oil exporting countries may be part of a more serious ailment. Countries may fall into a bad equilibrium in which investors are reticent to invest in opportunities in the non-oil tradable sector because they fear that the exchange rate may move so as to make the investment unprofitable. This causes the tradable sector to be relatively small and concentrated in activities where economic rents, arising from natural resources, provide a cushion that allows them to survive RER fluctuations. If the economy is sufficiently diversified, the RER may be quite stable.

In this framework, we can distinguish between first-best and second-best policies. The former involve interventions that complete the financial and investment markets so that investors behavior becomes less risk averse. Second best policies involve transferring the risk faced by the tradable sector to the rest of society. By so doing, investment in tradables would go up and the volatility of the real exchange rate would decline, an externality that private investors fail to take into account. We shall come back to policy recommendations below, but before we would like to delve deeper on the connection between the RER and growth.

The level of the real exchange rate and the growth process

The level and volatility of the RER affect growth in several ways. Obviously, a stable and predictable macro environment will facilitate a smoother functioning of the economy and make investment and growth easier. This is conventional, but may understate the importance of the effect because it does not make it interact with sources long-run growth.

Clearly, a sharp increase in the relative profitability of tradables is an important contributor to igniting and sustaining growth. By contrast, a significant process of real appreciation could choke off non-oil tradable activities, rendering growth more dependent on oil and hence more susceptible to negative shocks.

There are traditional arguments in favor of macroeconomic stability (and hence RER stability) in supporting a good growth environment. We would like to complement these with the following microeconomic reasoning based on the importance we place on self-discovery. In a small open economy like Kazakhstan, the greatest returns to discovering high-productivity activities lie among tradable goods and services. This is so, because such activities can cater to the global market, instead of the small domestic market and hence, each discovery can be scaled to a much larger extent and hence make it much more valuable from a social point of view. In addition, it is harder to create the incentives for self-discovery in the tradable than in the non-tradable sector. This arises from the fact that an innovator in the non-tradable sector –by definition – will start being a monopolist in that activity until he is copied by some other entrant in the local market. This period of monopoly may help create the rents that constitute the pay-off to entrepreneurship. By contrast, the first to produce some tradable good or service in Kazakhstan will not be the first in the world and hence will be participating in a market where there already is pre-existing competition. Hence, in this sector there is least room for entrepreneurial rents to stimulate experimentation and self-discovery.
In this context, sustained real exchange rate depreciation increases the return to such entrepreneurship and acts as a subsidy to self-discovery in tradables. Its impact on aggregate productivity and economic growth can therefore be sizable. Hausmann, Pritchett and Rodrik (2004) find that growth accelerations tend to occur in periods in which the real exchange rate is significantly more depreciated than in the preceding period.

Real exchange rate volatility and the growth process

As mentioned above, large swings in the real exchange rate are not uncommon in developing oil exporting countries. For example, for Venezuela, between 1980 and 2003 the percentage distance between the most appreciated RER (observed in 1982) and the most depreciated RER (observed in 1990) was 167.8 percent. Even if we take 5-year moving averages, in order to capture the idea that investors may be able to look beyond short term fluctuation and look at longer term returns, the percentage difference between maximum and minimum amounts to 116.3 percent2.

This fact has two implications. First, real exchange rate volatility directly interferes with the self-discovery process. Following the line of argument by Aghion et al (2004), the fact that self-discovery activities tend to have longer term returns than physical capital investment implies that they face more real exchange rate uncertainty. If the financial system is not developed enough to overcome these risks (as is the case in all developing countries), self-discovery will be depressed and investment will be concentrated on the accumulation of physical capital to exploit existing ideas. Empirically, Aghion et al (2004) find that real exchange rate volatility is most damaging of growth in developing countries.

Consistent with this finding, the arguments in Hausmann, Panizza and Rigobon (2004b) referred to above (in which RER volatility reduces the incentives to invest in tradables and hence lowers openness and increases volatility) may also involve a low growth equilibrium.3

The second implication of the large volatility of the real exchange rate in oil exporting countries is that it will tend to overwhelm modest microeconomic policy interventions to promote diversification. The impact of any finely-tuned set of tax and/or subsidy incentive programs is likely to be swamped by large movements in the real exchange rate in either direction. Microeconomic interventions matter less when the real exchange rate is (and stays) super-competitive; they will hardly make a difference when the real exchange appreciates. Today, it may make sense to invest in new seed varieties in rice, to control foot and mouth disease through tracking, to develop forests, plants and ports to export pulp and paper, to promote tourism in third markets and to provide the right institutional framework for the export

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2 We did these calculations using multilateral real exchange rate data from the International Financial Statistics. If we instead use the data JP Morgan we get instead 121.8 percent difference between the peak and the trough and 86.6 percent between 5-year moving averages.

3 Koren and Tenreyro (2004) propose an alternative mechanism through which RER volatility would lead to lower growth. They argue both theoretically and empirically that the high RER volatility in developing countries is the product of low diversification into differentiated intermediate inputs, as firms will have more difficulty in responding to any shock to any given input. If investment in intermediates is thwarted by high volatility and at the same time increases it, this may constitute another form of a low growth trap.
of software, calling centers and other services. However, if the real exchange rate were to move by 60 percent, these activities will make much less sense and the economy will not develop the efforts that will allow these sectors to become productive and competitive.

Here may lie in part the secret of the Chilean experience. After the dramatic collapse of the economy in 1982, Chilean economic policy became focused on preventing real appreciation through a myriad of instruments: crawling bands, massive intervention and sterilization, fiscal austerity, taxes on capital inflows, debt-equity swaps, internalization of the pension fund portfolios and others. Probably, beyond the effectiveness of each instrument lies the fact that investors understood that it was a policy goal of the government to protect the competitiveness and stability of the real exchange rate. This implicit contract may have had a lot to do with the growth experience of Chile.

Managing the real exchange rate

We have argued that the real exchange rate may impact long-run growth through a set of unconventional channels which constitute externalities from the point of view of individual agents. Hence, a market-determined level and volatility of the RER may be socially inefficient and policies should be able to improve on them.

A commitment to a competitive and stable real exchange rate

It is fashionable these days to argue that monetary authorities should declare a commitment to low inflation and to reserve for itself operational discretion as to how to achieve this objective. If the commitment is serious and the set of instruments is powerful enough to achieve its goals, such a statement may also be credible and effective. We argue that the same overall logic applies to the real exchange rate although the policy apparatus may be quite different.

A credible commitment to a competitive and stable real exchange rate would reduce the risk of self-discovery activities and investments in tradables and would increase the effective openness and diversification of the economy. This will reduce RER volatility. In addition, it will lower the relative importance of oil on the economy further stabilizing the RER. Finally, a more open economy will have a larger political constituency in favor of a competitive and stable RER, thus making its commitments in this area politically more credible.

Hence, we would argue in favor of the idea of making the competitiveness and stability of the RER become a major commitment of the development strategy of Kazakhstan. It is important to understand the temptations that may pull the country away from this goal. First, from a fiscal and financial point of view, a more appreciated exchange rate –ceteris paribus– implies that the weight of dollar-denominated debt to GDP ratio will be lower. Would this not be a better strategy to improve the financial stability of the country? But ceteris is not paribus. A more depreciated and stable RER will cause GDP and exports to rise faster and the current account to be stronger, leading to both a slower growing numerator and a faster growing denominator. This is bound to lead to a more sustainable reduction in debt ratios.
Second, a more appreciated RER, will lead to a lower price of tradables, such as food, and these enter significantly in the consumption basket of the poor. Would this not be better for welfare? Again, this is a very static argument. A strong RER would lead to higher unemployment and less higher-productivity job creation through the growth and discovery process.

Beyond its desirability, the question is whether a more competitive and stable RER can be achieved through policy? And if so, how? We believe it can and will discuss which policy instruments to use for this purpose. We shall discuss fiscal policy, where the arguments outlined strengthen the case for prudence, and monetary, exchange rate and financial policies, where we depart more from the conventional wisdom.

**Fiscal policy**

In the long run, the real exchange rate will be impacted by the balance between aggregate supply and aggregate demand. A stronger demand will lead to a more appreciated RER. Large fluctuations in aggregate demand will lead to a volatile long-run RER. In a world without full Ricardian equivalence, fiscal policy can play a stabilizing anti-cyclical role. It can go into surplus when other sources of demand go up—say because of an oil boom or a capital inflows boom—and move into deficit when conditions worsen. However, a necessary condition for this to happen is that the overall solvency of the government be perceived as strong. A government with precarious creditworthiness will not be able to borrow in bad times to cushion the blow or to incur in quasi-fiscal losses at the Central bank as part of a sterilization strategy. In this respect, targeting a cyclically adjusted fiscal surplus, as Chile has been doing lately, with an appropriately designed rule on oil revenues would be appropriate. As the surpluses accumulate and the economy grows, debt ratios will decline in a sustained manner and the anticipation of this trend will lower the cost of debt service much sooner. Prudent and anti-cyclical fiscal policies would contribute to the goal of a competitive and stable RER.

**Monetary and exchange rate policy**

While in the long run, the RER is affected by aggregate supply and demand balances at full employment, in the short run, both the nominal and the real exchange rate are affected by equilibria in asset markets. In the standard Dornbusch (1976) model, exchange rate overshooting is the product of slow adjustment in the labor market in the context of fast adjustment in financial asset markets. So, what role should monetary and exchange rate policy play in achieving a competitive and stable RER?

The conventional answer is none. It is common to argue that the task of achieving low inflation is so difficult already and the central bank has so few instruments that complicating its task with additional goals would be counter-productive. This is in part based on the idea of the impossible trinity: it is impossible to simultaneously achieve international financial integration, monetary independence and an effective target on the exchange rate. You may achieve two but not three of these goals. With international financial integration you must either choose between an exchange rate target or monetary independence.
This has lead to the bi-polar view of exchange rate policies in which the central bank either pegs fully and credibly to a foreign currency – through dollarization or a currency board – or sets completely flexible exchange rates accompanied with some form of monetary or inflation targeting. After the failure of Argentine convertibility, floating exchange rates with inflation targeting have become the new fashion.

Let us discuss how they work and see how they may interact with conditions for growth and self-discovery in the tradable sector. The standard approach to inflation targeting starts with a central bank that announces its inflation target and adjusts monetary policy in response to inflation expectations. Monetary policy is usually done through an interest rate that the central bank either sets or affects through open market operations. Intervention through interest rates has become more common because the alternative – monetary targets – tended to generate volatility in exchange rates and interest rates associated with the fact that money demand is volatile, but central banks cannot incorporate this source of variation in their money supply decisions.

With inflation targeting, the central bank usually announces that it does not care about the exchange rate except in so far as it may affect inflation expectations. In this context, consider the following three shocks: an expansionary (or irresponsible) fiscal policy, an exogenous capital inflows boom and an oil boom.

An expansionary fiscal policy will lead to increased demand and inflationary expectations in the non-tradable market. The central bank would respond with a rise in interest rates which lower domestic demand and would appreciate the exchange rate, lowering the price of importables and exportables and causing a contraction in the tradable sector. This will free up resources to accommodate the increased demand of non-tradables. Through both mechanisms inflation would be moderated, but the non-oil tradable sector would face a contraction caused by real appreciation. In other words, monetary policy sacrifices the non-oil tradable sector in order to make fiscal irresponsibility compatible with its inflation target.

Consider now a capital inflows boom. Under an inflation targeting regime this will lead to exchange rate appreciation. This may moderate inflationary pressures allowing the central bank to reduce interest rates. The appreciation will lower the price of tradables and will reduce employment, investment and profits in this sector, thus freeing resources that will help expand the supply of non-tradables in order to accommodate the increased demand caused by the lower interest rates. Again, the non-oil tradable sector contracts in order to accommodate the capital inflow.

An oil boom will cause an increased demand for non-traded goods. This will raise inflationary expectations and the central bank would respond with a combination of higher interest rates and a more appreciated exchange rate. Again, the non-oil tradable sector will contract.

What is common about these three examples is that the tradable sector plays, in this strategy, the role of front-line troops in the battle against inflation. Its expansion and contraction is called upon in order to contain inflation. Even in the case when it is fiscal profligacy that causes the inflationary pressures, the policy solution involves a real appreciation in order to contract, not the non-tradable sector which benefited from the fiscal expansion, but the tradable...
sector which did not. Under these conditions, the battle for low inflation may be won more easily, but the casualties disproportionately fall in the level and stability of the competitive conditions faced by the tradable sector.

There is an added complication with the regime of inflation targeting when it is implemented in a country characterized by liability dollarization. Under these conditions, exchange rate fluctuations cause balance sheet effects that make a monetary expansion either less effective. When the central bank adopts an expansionary (contractionary) monetary policy, the concomitant exchange rate depreciation (appreciation) causes an adverse (favorable) balance sheet effect, making the impact less expansionary, or even contractionary (less contractionary or even expansionary). The balance sheet channel works against the normal channels of monetary policy limiting its impact on aggregate demand and forcing the central bank into larger interest rate movements (and hence real exchange rate changes) to achieve the same demand effect.

In addition, a pure floating regime would involve no exchange rate intervention which means that the level of international reserves is not used to accommodate shocks to the demand for money. Instead these get absorbed by the exchange rate and the interest rate, making them more volatile. It would be ideal to use the level of reserves to absorb at least part of that volatility so as to leave a more stable RER environment, but a pure inflation targeting scheme does not have a clear policy rule on how to do this.

For all these reasons, we believe that standard inflation targeting would not lead to a stable and competitive RER. Instead, it is bound to create too much RER and interest rate risk, and lead to other undesirable results, forcing the central bank into a series of modifications and ad hoc adjustments without a coherent policy, as for example, in Colombia.

We propose instead to peg the exchange rate to a basket and to allow a band of fluctuation around it. Fiscal policy should be set with an eye on the competitiveness and the stability of the real exchange rate. This can be achieved with a cyclically-adjusted fiscal surplus and an oil spending rule, as argued above. Monetary policy would be limited by the degree of monetary independence allowed by the band.

The underlying model behind this strategy assumes that the central bank cares not only about inflation and output today, but also about growth tomorrow, which is affected by the level and stability of the real exchange rate. Hence, the central bank needs to express a target for the real exchange rate and develop instruments to reach it. This is what we shall discuss below.

What should the central bank be ready to do when there are what it deems to be excessive pressures towards real appreciation, i.e. when it is defending the strong part of the band? The first order of business would be, of course, simple unsterilized intervention, i.e. with the purchase of international reserves with cash. This will expand base money and cause a reduction in interest rates. As the rates decline, capital will stop flowing in. However, the base money created in the process may lead to a credit boom which may potentially create expansionary pressures at home and cause inflation to accelerate with its negative effects on inflation and competitiveness. This risk should not be exaggerated. Consider, for example, the case of China. The country has purchased some US$ 480 billion in unsterilized international reserves and after a long period in which markets feared deflation, prices in 2004 are now rising at a rate of 5 percent
forcing the government to take action. However, this has not taken place through currency appreciation. Instead credit and public enterprise policies have been tightened. The point is that a policy of unsterilized intervention will at worst create inflationary pressures that are bound to happen gradually, through pressures in the labor market instead of suddenly through nominal appreciation. As they take place, there may be time to respond to them through other policies.

One alternative to unsterilized intervention is sterilized intervention, i.e. the purchase of international reserves but accompanied with an open market operation designed to limit the expansionary effect on the supply of money. We are less enthusiastic about this policy: it will lead to a potentially large quasi-fiscal deficit and may become unsustainable as it tends to keep interest rates high which will attract more speculative capital inflows. In the end, it may be expensive and ineffective.

Instead, we would propose to contain aggregate demand pressures through other means. Besides fiscal policy, already mentioned above, financial policies may help. An alternative to sterilization through open market operations is reserve requirements on banks. If sterilization leads to an expansion of monetary aggregates that are deemed too high and unsustainable, the central bank can act to lower the money multiplier. One way to do this is through increased reserve requirements. This will finance indirectly the purchase of international reserves by the central bank, but as opposed to sterilization, will lower deposit interest rates which will dampen capital inflows. These reserve requirements may or may not be remunerated, but the rate at which they are should be below the deposit rate.

Another instrument is the adjustment of capital adequacy requirements on banks. The expansionary effects of unsterilized intervention on bank credit can be limited by requiring banks to back up their credit with more of their own capital. This makes prudential sense because it will limit credit booms, which often end in tears. Moreover, it will make the capital adequacy requirement part of an anti-cyclical policy stance which is prudentially sound: when the external environment turns less buoyant, banks will have the capital base to face the coming difficulties.

An additional mechanism is to opportunistically fight liability dollarization in good times. When capital inflows threaten real appreciation, prudential norms regarding foreign borrowing of banks can be tightened. Foreign bank loans should under any circumstance be subject to reserve requirements. This will act as the equivalent of a tax on capital inflows, which can be adjusted given the circumstances. Dollar lending to non-tradable activities must generate a higher capital adequacy requirement in order to cover the implicit currency risk. This will limit the expansion of credit to the booming non-tradable sector while it will protect financial conditions in the tradable sector. If this is done effectively in good times, when the situation turns sour, the balance sheet effects will be that much smaller and the situation that much more stable.

In short, prudential norms on foreign borrowing by local banks can act as implicit capital controls while prudential norms on foreign currency lending can be used in a prudentially sound manner to avoid over-valuation.

In addition, foreign investment rules on pension funds can be adjusted to fight real appreciation. If capital inflows are excessive, foreign investment restrictions can be opportunistically relaxed. Internationalizing the portfolio of pension funds makes sense in order
to protect workers from the volatility in the local market. Doing this in bad times is impractical, as it would exacerbate external imbalances. But in good times, it allows to achieve a long-term goal while contributing to shorter term stability of the RER. As the experience of Chile shows, there is an additional benefit of allowing pension funds to invest abroad: they will help develop the market for long term currency hedges. As the liabilities of the pension funds are in pesos and part of their assets will be in dollars, they will want to enter long term currency swaps in order to protect their returns from an unexpected appreciation in the RER. This is the opposite fear of the one faced by dollar borrowers. The development of this market may help reduce and better distribute the currency risks caused by liability dollarization.

In synthesis, the central bank and the government can fight what they deem to be unwarranted real appreciation through an arsenal of potential tools that include fiscal contraction, unsterilized intervention, reserve requirements, capital adequacy requirements, requirements on foreign borrowing and the regulation of pension funds. The commitment to keep the RER stable and competitive need not involve a fixed RER with zero risk. The actual RER will fluctuate around the announced target. Instead, the target should be viewed as an implicit contract which signals the government’s intention and gives a sense of priority to its macroeconomic strategy.

The authorities can review their exchange rate basket in line with new information. For example, if the country has a tight labor market in the context of a current account surplus and relatively low terms of trade, this would constitute prima facie evidence that the RER is undervalued. But if unemployment is above its natural rate then it should wait until it expects it to come down before announcing a move in the peg. If the current account is in deficit, or if it is in a surplus attributable to unusually favorable temporary external conditions, it should not move its peg.

In addition, the authorities should treat the peg as a central parity. Through time the authorities and the market will learn about the effectiveness of its instruments and the credibility of its stance. If it is successful, the market will help achieve the target through stabilizing speculation, a la Krugman (1988).

With this approach we believe that the RER volatility that has plagued oil exporting countries can be significantly mitigated. If successful, the country will grow out of its volatility problem through increased openness and diversification. In the meantime, a clear commitment to a stable and competitive RER is a key element for the strategy of structural transformation.

**Fiscal policy and the National Fund (NFRK)**

Many of the effects of oil booms get transmitted to the domestic economy through its impact on fiscal policy and the government’s solvency. In good times, constraints on spending and borrowing are relaxed and spending may rise very significantly. In bad times, both income and borrowing tend to collapse. Ideally, the government should keep spending on an even keel and allow shocks to income to be absorbed by movements in the fiscal surplus and in international financial assets. Kazakhstan has moved in this direction with the creation of the National Fund.
As argued in the World Bank’s memo on the National Fund Concept and Macroeconomic Management, a national fund rule must be complemented with a constraint on the overall fiscal position of the government, lest the gross savings done at the NFRK be eroded by an overall deficit in the fiscal accounts or in the rest of the public sector. Hence, we suggest a simple balanced budget rule applicable to the broadest possible definition of government spending, excluding oil revenues but including the transfers from the NFRK as revenue. In addition, all government revenues coming from the oil industry should go to the NFRK and all oil income to be incorporated in the budget should come from it. This has the advantage of transparency, but will also make monetary policy easier to execute. In addition, we support the spending rule suggested in that report and provide in the appendix a procedure to estimate its parameters.

**Figure 1.** 5-year volatility of the real exchange rate 1980-2000
Appendix: Estimating the parameters of the NFRK rule

The formula for the transfers (T) from the NFRK to the government proposed in the World Bank memo is given by:

(1) \[ T_t = A + b \cdot F_{t-1} \]

where \( A \) and \( b \) are parameters and \( F_{t-1} \) is the level of the Fund at the time of approval. This formula combines the benefits of a rule based on permanent income (which would set \( b \) to zero) and one based on a bird-in-hand view (which would set \( A \) to zero).

The question is how to choose the parameters \( A \) and \( b \).

First, it is important to note that \( b \) should NOT be the average expected return on the NFRK. Instead, it should be LARGER than the expected return. In addition, \( A \) should be smaller than the expected long-run level of oil income. To see why, let us solve for the steady-state equilibrium level of the fund, i.e. the level of the fund if oil income were to stabilize forever at a level \( Y \).

First, note that

(2) \[ F_t = Y + (1 + r) \cdot F_{t-1} - T_t \]

(3) \[ F_t - F_{t-1} = Y + r \cdot F_{t-1} - T_t = Y - A + (r - b) \cdot F_{t-1} \]

where \( r \) is the rate of return of the NFRK we substituted equation (1) in equation (3)

The steady state is achieved when

(4) \[ F_t - F_{t-1} = 0 \text{ or equivalently } F_t = F_{t-1} \]

Therefore, to calculate steady state values, we can drop the time subscripts. In addition, it is convenient to transform the variables into shares of steady state oil income \( Y \), so that \( f = F/Y \), and \( a = A/Y \).

(5) \[ f = F/Y = (1 - a) / (b - r) \]

For the fund to have a well behaved steady state, two conditions must be met. First, \( A \) should be (significantly) less than steady state \( Y \) so that the parameter \( a \) is (significantly) less than 1. This means that \( A \) should be no more than a fraction of what is conservatively estimated to be the long run level of oil income \( Y \).

Second, \( b \) must be greater than \( r \). If instead \( b \) is set equal to \( r \) and \( A < Y \), the fund will not have a well-defined steady state level, but instead will grow to infinity. This will presumably lead to the abandonment of the formula, at its result will not be economically efficient or socially acceptable.

\[ ^4 \text{If } a \text{ is close to } 1, (1-a) \text{ will be close to zero and there will be little long term saving in the fund. } \]
To understand the magnitudes that the fund could take, note that if \( a = 0.5 \), \( b = 0.1 \), \( r = 0.05 \) then the fund will stabilize at a level that represents 10 years of oil income. So to make matters concrete, if the steady state level of oil income resembled the income of the past three years (6 percent of GDP), then these parameters would create a fund equivalent to 60 percent of GDP and annual transfers of 9 percent of GDP\(^5\).

I propose the following algorithm to choose the parameters.

1) Choose \( b \) based on how much stabilization is desirable. Given the simulations presented in the August Aide Memoire, a number such as 10 percent would seem reasonable.

2) Choose the level of government spending for 2006, and estimate the levels of non-oil income and non-oil deficit consistent with the macroeconomic objectives of maintaining low inflation and a competitive real exchange rate. I suggest that after such a sustained period of fiscal expansion as that experienced since 2000, a more conservative rate of real domestic spending growth be chosen. I understand that in 2004 the non-oil fiscal deficit was somewhat larger than 3 percent\(^6\). I would hope that in 2006 this number were smaller.

3) Choose the level of transfers \( T \) that would equal the expected non-oil deficit.

4) Calculate \( A \) as the difference between this planned deficit and \( bF_{t-1} \).

5) Check that the number \( A \) you get is (significantly) smaller than the expected long term oil revenues.

Let me give a numerical example. Suppose the desired non-oil fiscal deficit is 3 percent of GDP and that the level of the fund equals 10 percent of GDP. Then \( A \) should be set at the equivalent of 2 percent of expected 2006 GDP. Call this number \( A' \)

In this example, the law would state that the transfers from the fund would be equal to:

\[
T = A' \times CPI + 0.1 \times F_{t-1}
\]

where CPI would be the CPI index with base year 2006.

Note that if oil revenues for 2006 were 6 percent of GDP and the return of the fund was 5 percent, the fund would grow by an amount equivalent to \( Y - T + rF_{t-1} = 3.5 \) percent of GDP.

With respect to the depletion formula, I would amend equation (6) by requiring the following restriction:

\[
T < c(F_{t-1} + Y)
\]

\(^5\) Note that the 9 percent in transfers would come from the sum of 6 percent of GDP in oil income plus 3 percent of GDP, given the 5 percent return on a fund of 60 percent. The formula would make \( A \) equal to 3 percent of GDP and \( bF \) equal to 6 percent of GDP, hence also producing 9 percent of GDP in steady state transfers.

\(^6\) According to Pedro Rodriguez, in 2004 oil inflows were 6 percent of GDP, of which 44.8 percent were saved.
To get a feeling for the values, I simulate the formula assuming that we start from a steady state situation. Let us see what would happen if oil revenues went from 100 to zero and stayed there for 3 years. Starting at the steady state, the depletion formula would never come into effect and the path of the transfers would be given by the following schedule. Note that in period 5 transfers to the government are still 151.5, even though oil revenues have been zero for three years.

**Figure 1.** Simulation 1: A decline of oil income to zero for three years, starting with the steady state

![Graph](image)

Note: $Y = 100$, $F(\text{steady state}) = 1600$, $A = 20$, $b = 0.1$, $r = 0.05$.

If we assume a parameter $c$ of 0.2, the depletion formula would not come into effect in this example. In fact, if we assume that oil income drops to zero forever, starting from steady state, it would take 25 years for the depletion formula to bind. This is shown in Figure 2. The yellow line is the actual transfer, while the blue line is the transfer in the absence of the depletion constraint.
Figure 2. Simulation: Permanent collapse of oil income

Note: $F(\text{initial}) = F(\text{steady state})= 1600$, $A = 20$, $b = 0.1$, $r = 0.05$, $c = 0.2$,

Figure 3 presents the value of the transfer for three different values of the parameter $c$. Note that with $c = 0.2$ the depletion restriction does not become binding until year 25. For $c = 0.15$, it does not bind until year 19, while for $c = 0.1$, it binds from the very beginning generating a smaller level of transfers in the first years after the shock. However, after year 14 the situation is reversed: because of the tougher constraint on the depletion formula, the level of the fund is higher and allows for a higher future level of transfers.

Summing up, the depletion formula is really not that necessary. It will only bind if something quite disastrous and sustained happens to oil income. If such a depletion formula is adopted, a reasonable number would be 0.15 or 0.2. I think that 0.1 defeats the stabilization purpose of the fund.
Figure 3. Simulation: Permanent collapse of oil income, three values of the depletion parameter

Note: $F(\text{initial}) = F(\text{steady state}) = 1600$, $Y(\text{initial}) = 100$, drops to 0 in year 2, $A = 20$, $b = 0.1$, $r = 0.05$