INTEGRATED EXCHANGE RATE MODEL (IERM) & CHINESE YUAN & US DOLLAR: THE CASE OF WORKING CAPITAL MANAGEMENT IN LOGISTICS

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Abstract

With the transportation of goods over long distances not just goods but also an inventory is being shipped. The value of this inventory could change due to the fluctuations in the exchange rates of the involved (international) currencies. This article introduces an integrated exchange rate model to help shippers and transporters with this aspect.

Introduction

Over the last 2 decades we have seen a trend of internationalisation in the supply chain, especially in outsourcing to China (Eiteman, Stonehill & Moffett, 2010). As a result, companies based in the USA en Europe are more and more exposed to the Peoples Republic of China (PRC)’s Yuan. As the Yuan is pegged to the US $ by the People’s Bank of China, the Yuan shows a strong undervaluation towards the US $ (of 30% – 50%) (Eiteman, Stonehill & Moffett, 2010).

For an international operating company it is useful to have knowledge about how to manage exchange rate exposure in their (net) working capital (Ross, Westerfield & Jordan, 2008); as inflows and outflows of money in the company’s value chain are more and more determined by foreign currencies (directly or indirectly in the supply chain).

In this article the five fundamental forces of exchange rate determination will be discussed in a non-mathematical way; so entrepreneurs can make a qualitative forecast for their decisions to hedge against exchange rate exposures.

The integrated exchange rate model (IERM) is developed by the author. The author is influenced by the 9 textbooks in the reference list of this article: the old ones (1970’s) as a student and the new ones (1980’s and later) as a (senior) lecturer of International Economics and International Finance. IERM consists of five fundamental forces:

1 Central banks
2 Interest rate differentials
3 Inflation rate differentials
4 Balance of payments
5 Psychological and political influences
Central Banks play an important role in the exchange rate determination; they can have direct intervention (buying / selling foreign currencies to back up their domestic currency) and /or indirect intervention (influencing the national short interest rate structures; because of that influencing the short term international interest differential; and thus influencing short term capital inflow and outflows).

Interest rate differentials are a driving factor of capital flows between countries (Capital account of the balance of payments). Suppose the interest rate on the capital market of the €uro region increases (ceteris paribus the interest rates in the USA and the rest of the world); there might be an inflow of foreign currencies to the €urozone (so more demand for €uro’s in the USA and more supply of US $’s in the €urozone).

Inflation rate differentials have always had a fundamental / underlying role in the long term development of exchange rates (Krugman & Obstfeld, 2009). The well known Big Mac Index (published by the Economist on their website) gives us insight in the fundamental external currency value. In general countries with a high inflation percentage also have a weak exchange rate.

Balance of payments are traditionally important to explain exchange rates (Krugman & Obstfeld, 2009), we distinguish the current account (for import and export of goods, services and income transfers) and the capital account (for export and import of capital). So money flows between countries have a tremendous influence on the price of currencies (e.g. exchange rate). Underlying factors of the current account are the national business cycles and the competitiveness of countries à la Michael Porter (Hill, 2007). The capital account of the balance of payments deals with the short and long term capital movements, caused by international interest rate differentials.

Psychological and political influences (Ohmae, 1995) have in the very short term a quite dominant influence on the exchange rates of currencies. Mass behaviour based on self fulfilling prophecies is sometimes based on non-rational behaviour; and can cause quite important distortions on the currency markets. It is well known that monetary authorities have a strong reason for having international meetings on Saturdays and Sundays: to not influence the financial markets.

Exchange rate exposure is an important part of daily business risk for companies active in the global economy. Every enterprise nowadays is (direct or indirect) connected to international supply chains; so from costs (input) and revenues (output) the company’s value chain is exposed to currency risks. In an operational way this is part of the working capital management (Ross, Westerfield & Jordan, 2008) of the company; object of this article is to optimise the use of working capital management in an international business environment.
Markets for exchange rates

An exchange rate is in fact a price for a foreign currency expressed in an domestic currency (Samuelson & Nordhaus, 2009), so on the currency exchanges in New York (USA) and Shanghai (PRC) we can observe the exchange rates CNY/US $ and US $ / CNY:

<table>
<thead>
<tr>
<th></th>
<th>New York CNY/US $</th>
<th>Shanghai US $/CNY</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 16th 2010</td>
<td>6.82549</td>
<td>0.14651</td>
</tr>
</tbody>
</table>

Table 1 Exchange rates of the US $ and the CNY (source x-rates.com on 2010-10-24)

In terms of supply and demand graphs the markets are cleared when supply and demand intersect; and thus the exchange rates are established in the equilibrium (where supply meets demand or $Q_S = Q_D$). Both graphs for the currency markets in New York (for the CNY) and the Shanghai (for the US $) show this.

The demand for a foreign currency depends ($Q_D$ in the graph) in fact of the two main balances of the balance of payments: Current Account and Capital Account. So the import of goods and services (Current Account) and the export of domestic capital to foreign investment opportunities (Capital Account) cause a demand for foreign currencies.

Mutatis mutandis the supply of a foreign currency ($Q_S$ in the graph) depends on the export of goods and services (Current Account) and on the import of foreign capital for domestic investment opportunities (Capital Account); both cause a supply for foreign currencies. In the last section of this article we will take a closer look at the balances of payments of the US and the PRC; so we might give a forecast of a certain exchange rate development.
The integrated exchange rate model

The Integrated Exchange Rate Model (IERM) is a model of some mainstream theories in the field of international economics; explaining the (static) exchange rate determination on (spot) markets for currencies.

As a summary of those mainstream theories we distinguish five fundamental forces (Figure 2):
1 Central banks
   a Direct influence: Currency Intervention
   b Indirect influence: Discount policy domestic money market
2 Interest rate differentials (In fact Capital account Balance of Payments)
   a International Money Markets
   b International Capital Markets
3 Inflation rate differentials
4 Current Account Balance of Payments
   a Business Cycles
   b International Competitiveness
5 Psychological and political influences
The purpose is to make exchange rate developments understandable for the generally interested user of exchange rate information; the underlying theoretical structures (without using mathematics; a tool economists often use) are not explained within the scope of this article (but can be found in the textbooks in the list of references).

The coming sections of this article will explain step by step the theoretical background of the five forces of the Integrated Exchange Rate Model.

The model is integrated, because all five forces are having a simultaneous influence on the exchange rate determination; sometimes one factor might be dominant in explaining exchange rate developments.

Central banks

Central banks (in this case the Fed (Federal Reserve System) for the USA and for China the Peoples Bank Central Banks) in general have two important goals:
1. Internal price stability; often called inflation / deflation and measured by the CPI (Consumer Price Index)
2. External price stability; no fluctuations in the national exchange rate (depreciation / appreciation under flexible exchange rates or devaluation / revaluation under fixed exchange rates)

To maintain (internally or domestically) price stability (measured by the Consumer Price Index (CPI)) central banks often use the short term interest rate instrument (discount policy) to effectuate price stability. When the central bank raises short term interest rates, banks will charge their clients a higher interest rate as well. Because of the higher interest rates consumers and enterprises will borrow less for consumption and investment; so aggregate (macroeconomic) demand will contract. As a result of the contraction of macroeconomics demand, prices in the economy will not increase that much (so the CPI will not increase that much anymore). This internal adaption process (via short term domestic interest rates) has of course influence on the international short interest rate differential. Assuming no rise in short term international interest rates will take place nor a rise in domestic short term interest rates, this country will be more attractive for short term (portfolio) investments. And because of that the demand for this currency will increase; thus the exchange rate for this country will have a tendency to increase (ceteris paribus). The role of interest rates will also be explained in the section about interest rate differentials. In the IERM graph (figure 2) this effect is the dotted line from the monetary policy to the international money market developments (this is called the indirect effect).
The central bank can also decide to have currency intervention, to maintain a certain level of external price stability or exchange rate stability. Exchange rate stability is important for the development of international trade of a country and the rest of the world. The IMF wants to prevent international chain reactions of devaluation / depreciation to improve international competitiveness for one country as is shown by Articles of Agreement of the International Monetary Fund (website IMF). A central bank can for instance sell foreign currencies (e.g. buy domestic currencies) to back up their weak domestic currency or to buy foreign currencies (e.g. sell domestic currencies) to lower pressure on their strong domestic currency (this is called the direct effect). Successful currency intervention depends very much on international co-ordination between central banks (and the IMF).

**Interest rate differentials**

This section deals with the international capital flows on several financial markets; the capital market (for long-run financial flows) and the money market (for short run financial flows). These financial flows are registered on the capital account and financial account of the balance of payments.

In the previous section the money market flows have already been explained; they result from interest rate policies of central banks. Beside central banks, the interbank bank markets play a dominant role in short-term money flows in the world; the interbank market is a wholesale market for banks that have an excess liquidity and banks that have an excess illiquidity.

Long term interest rates are composed of 3 basic factors (Eiteman, Stonehill & Moffett, 2010):

1. Real interest rate
2. Inflation mark up
3. Risk mark up

The real interest rate is the basic interest rate in a world without inflation and without risk, in some economies (website The Economist) this interest rate is about 2% or 2.5% for premium state bonds. Because of inflation and risk, the market interest rate can be 10% or more. Capital market flows have a tendency to flow to the country with the highest (expected) real interest rate; so there will be a demand for this currency; and thus the exchange rate of that currency will increase. Sometimes also other arguments play an important role in investing in a safe haven economy; like political stability, a sound financial system and of course reliable banks.
Inflation rate differentials

Inflation rate differentials have a long tradition in economic theory of exchange rate explanation: Purchasing Power Parity (PPP) theory.
A popular variant of this PPP-theory can be find in the well know Big Mac Index from the website of the Economist from 16 October 2010, we can calculate the costs of a Big Mac in the USA (US $ 3.71) and in China (US $ 2.18). So the CNY is undervalued of more than 40% to the US $ \{(2.18-3.71)/3.71\}.

Question now is: Is this caused by inflation differences between the USA and PRC?
In the Economist(website the Economist) from 16 October 2010 we can find some data:

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010 (forecast)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRC</td>
<td>-1.2%</td>
<td>3.0%</td>
</tr>
<tr>
<td>USA</td>
<td>-1.5%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Table 2 Inflation rates (CPI)

According to the PPP-theory PRC (3.0%) shows more expected inflation than the USA (1.6%); so the CNY is expected to depreciate / devaluate at about 1.378% (the difference in inflation rate tempi between the PRC and the USA).

This is actually not what we would expect looking at the current situation of the CNY (compared to the US $) shown by several articles in the Economist from 16 October 2010; so there is apparently another dominant explanation for the strong CNY. This explanation will be provided in the section of this article: Balance of Payments.

Balance of payments

The US imports 19.3% of its imported goods from PRC (source www.cia.gov); so there is strong imbalance in the balances of payments of both countries; as indicated below in table 3.

<table>
<thead>
<tr>
<th></th>
<th>Trade balance (in Billion US $)</th>
<th>Current Account (in Billion US $)</th>
<th>Current Account (in % of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRC</td>
<td>+182.9</td>
<td>+289.1</td>
<td>+4.9</td>
</tr>
<tr>
<td>USA</td>
<td>-604.7</td>
<td>-430.9</td>
<td>-3.3</td>
</tr>
</tbody>
</table>

Table 3 Balances of Payments
Moreover the Reserves of foreign exchange and gold (World fact book) of both countries differ a lot: The PRC has a value of $2,422,000,000,000 (1st place) and the USA has a value of US $130,800,000,000 (17th place).

So, on the currency markets the CNY has a stronger position than the US $, because of the high surplus on the balance of payments (current account) and the high level of international reserves; from this perspective an appreciation / revaluation of the CNY (or a depreciation / devaluation of the US $) might be expected.

As we can see now the 5 forces of the integrated exchange rate model are simultaneously influencing the exchange rate level; they can reinforce each other and/or be contrary.

The current account of the balance of payments of a country is in fact influenced by 2 fundamental causes:

1. The business cycle
2. The (global) competitiveness

In a (global) recession exports have a tendency to fall more heavily than the imports; so the current account of the balance of payments has a tendency to have a quite strong fall in the balance. So we observe rapidly growing deficits and/or rapidly diminishing surpluses.

The current account is a good yardstick for the strength of an economy in the global competition; if a company is flexible and competitive their potential competitiveness is excellent in the global economy (Hill, 2007). So the country has also a (possible) potential surplus on their trade balance and/or current account.

Psychological and political influences

Psychological and political influences are especially relevant for short-term explanations in the volatility of the currency markets (and also other (financial) markets in the economy); speculative behaviour and the anticipation of such behaviour can cause huge distortions on currency markets (more than the 4 other more fundamental forces) (Ohmae, 1995).

Often an expected political announcement (made by the IMF, Central Banks and or other monetary authorities) causes positions (net-selling or net-buying by banks, currency brokers, Multinational Enterprise (MNE)’s etc.) on currency markets; and because of that other participants are going to sell (or buy) more. The effect on the exchange rate of the currency will then be a quite strong decrease (or increase) because of self-fulfilling prophecies.
For this kind of irrational mass-behaviour there no rational explanation from economic theory can be provided, but it is still a realistic phenomenon occurring on financial markets all over the world. Often market authorities stop the trade in currencies to prevent high speculative behaviour and to put on hold the non-desired outcome of that speculative behaviour.

**Exchange rate exposure on firm level**

We distinguish 3 sorts of exchange rate exposures on company level (Eiteman, Stonehill & Moffett; 2010):

1. Operational / Transaction exposure
2. Economic exposure
3. Translation exposure

Operational / Transaction exposure is linked to a contract to import (or to export) goods and services. Suppose a US company imports components from China; and the contract is in CNY’s. Suppose we are talking about a full container load of technical components AR-500-Z for an amount of CNY 600,000 (CIF (Costs, Insurance and Freight) condition); the contract was established at 16 April, 2010 and payment (after delivery in the USA) to be expected 1 October, 2010. Suppose the US company wants to have no exchange rate risk and decides to buy now (16 April) CNY 600,000 for an amount of US 87,906 \{CNY 600000 : CNY (per $) 6.82549\}. The cost of this hedge transaction is in terms of missed interest: 164 days (month = 30 days) \(\times\) 1.5% PA (assumption interest rate in USA); so in opportunity costs:

US $ 601.

Of course there are other hedge instruments like currency options and currency futures. Looking backwards (after completing the transaction on 1 October) the costs of the transactions are US $ 89,671 \{CNY 600,000: CNY (per $) 6.6912\}; but the US company did not know this exchange rate on 16 April.

Of course there are more possible hedging strategies (Eiteman, Stonehill & Moffett, 2010; Hill, 2007) for the operational exposure:
- No hedging (often combined with a currency provision ledger)
- Foreign currency account
- Pricing in domestic currency
- Leading & lagging
- Currency forward contract
Integrated Exchange Rate Model (IERM) & Chinese yuan & US dollar: The case of working capital management in logistics

- Currency future
- Currency options
- Barter trade
- Netting flows of currencies

Economic exposure provides the company with the opportunity to make choices because of changes in prices of imported products and services; in running contracts (operational exposure) it is impossible to adapt and the company has to accept the outcome in terms of costs and benefits. The adaption can show a range of scenarios (Eiteman, Stonehill & Moffett, 2010):

1. Accept increased cost in local currencies and
   a. lower the profit margin
   b. maintain the profit margin and charge higher prices to clients
2. Look for cheaper suppliers
   a. Abroad:
      I. existing supplier
      II. new supplier
   b. Domestic supplier
3. Innovations of production and/or product resulting in lower costs

Translation or accounting exposure is not so relevant within the scope of this article; but for instance relevant in the case that the US company is having a joint venture with a Chinese company. And the US company is going to finance for instance a new production plant in the PRC financed with US capital (for instance issued with new shares and new bonds). The value of the joint venture plant is a topic of study of translation exposure; especially when this PRC joint venture is consolidated (let us assume for 49%) in the annual report of the US company.

Case study: Working capital management in logistics

Figures 3 and 4 provide us with information over 6 months of exchange rate development of the CNY and the US $. The Chinese central bank (currency board) has a policy of fixed/managed exchange rate of the CNY towards the US$ (Eiteman, Stonehill & Moffett, 2010). As already stated in the sections about inflation rate differentials and balance of payments the CNY seems to be undervalued to the US $ or the US $ is overvalued to the CNY.
In table 4 the moments and the relative change (% Δ) of the exchange rates are summarised (16 April and 1 October).

<table>
<thead>
<tr>
<th>April 16th 2010</th>
<th>CNY/US $</th>
<th>US $/CNY</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.82549</td>
<td>0.14651</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Oct 1st 2010</th>
<th>CNY/US $</th>
<th>US $/CNY</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.69117</td>
<td>0.14945</td>
<td></td>
</tr>
</tbody>
</table>

| % Δ            | -1.97%    | 2.01%     |

Table 4 Exchange rates of the US $ and the CNY

So what does this mean for business operations at company level? Suppose we are the US company (from the previous section) importing components AR-500-Z for an amount of CNY 600,000 (CIF condition) from PRC.
Table 5 provides a summary of activities concerning the import of component AR-500-Z.

<table>
<thead>
<tr>
<th>Activity</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
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<tbody>
<tr>
<td>Contract</td>
<td></td>
<td></td>
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<tr>
<td>Production PRC</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Production USA</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Domestic Transport</td>
<td></td>
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<tr>
<td>Sea Transport</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Payment</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 *Overview of activities of importing component AR-500-Z*

We can distinguish a few risks:
- Currency risk
- Price risk of inventory during the pipeline time
- Quality risk of components delivered
- Transport risks (for instance damage)
- Legal risks (for instance a permit to export or to import; health certificate; certificate of safety & quality standard; etc.)
- Payment risk (reliable banks)

We will now return to the main focus of this article: The currency risk is quite obviously to be studied more closely, next to ways of dealing with risk (hedging policies).

As already stated in the previous section, the US company made a choice to buy CNY in advance and to have no speculative position (ex post not so interesting, because the exchange rate dropped). Let us sum up possible strategies for a company importing goods from another currency area:
- Buy foreign currency in advance
- Buy a call currency option (a right to buy in this case CNY and to pay with US $)
- Buy currency futures (an obligation to buy in this case CNY and to pay with US $)
- Netting flows of incoming and outgoing CNY’s in the company or with another (US) company
- Forward currency contract
- Borrow locally
- Barter trade between the PRC and US company (eventually with more companies to clear positions)
- No hedging actions, just accept the currency risk.
Naturally the different policies we have distinguished have their price; we already calculated the opportunity costs of US $ 601 in the previous section of buying foreign currency in advance. Buying options and futures are of course also not for free and you have to include transactions costs as well. Netting and barter trade often involve a lot of time (and so costs) to clear positions.

So you really have to make a good trade off of all costs involved (including time related costs) including covering a certain risk. By not covering a currency position you might suffer of course serious currency exposure risks, but no costs are involved (in terms of cash outflow)! So you might reserve amounts of money on a special provisions account; as a kind of internal hedging strategy.

Buying foreign currency in advance is also a very transparent strategy, telling you in advance what your costs will amount to. Moreover this is a very transparent strategy, especial as most SME’s do not have specialised treasure departments. For MNE’s (with specialised treasury departments) the scenarios naturally are more open to more complicated hedge strategies such as currency options, currency futures, (internal) netting and (internal) barter trade.

**Literature**


McGraw Hill


Integrated Exchange Rate Model (IERM) & Chinese yuan & US dollar: The case of working capital management in logistics

www.iccwbo.org
www.ecb.eu
www.economist.com
www.imf.org
www.x-rates.com