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RESEARCH ESSAY

**ESTIMATION OF THE POLAK MODEL FOR
A DEVELOPING COUNTRY UTILISING
THE CURRENCY BOARD:
CASE OF ESTONIA**

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SUMMARY

In recent years many countries have revived interests in Currency Board arrangements as a means to stabilise their own currencies and control the inflation. The successful reintroduction of the currency board by Hong Kong in 1983 was followed by Argentina, Djibouti, Estonia and later Lithuania. Currently Bosnia and Herzegovina are about to establish such monetary arrangements. The main attractions of the currency board arrangements for developing countries are the strict limitations they place on the magnetisation of government deficits and the provision of domestic credits to the banking sector.

In June 1992, Estonia, a member of the International Monetary Fund, was the first among the countries of the former Soviet Union to introduce its new currency, the kroon, under a currency board arrangement. This step was taken in order to break away from the Soviet mono-bank system and introduce economic reforms in independent and sovereign Estonia. The currency board arrangement was chosen to provide a relatively easy way to achieve monetary stability and convertibility, and control, and generally support, economic reforms and development.

The purpose of this paper is to estimate the coefficients v , income velocity of money, and m , marginal propensity to import, for developing countries that are using the currency board arrangement, and to test the hypothesis that v and m are expected to be higher for a country using the currency board arrangement than for countries that do not. This hypothesis is based on the fact that countries using the currency board arrangements have tight monetary policies due to moderation of credit expansion, and do not allow monetization of government debt. The low inflation economy and strong, credible and easily convertible national currency would result

in increased trade with the rest of the world. As a result a country will be able to afford more imports per unit of national income. This implies a higher marginal propensity to import.

Estonia is portrayed as a particular example of a developing country that decided to use the currency board arrangement as a major element of their stabilisation program.

The Polak model for developing countries has been selected to test this hypothesis. This model is well suited to do so because it is a simple model that clearly brings out the main relevant features and interrelationships of a particular economy, and thus points out certain major relationships important for policy purposes. More refined models are generally insufficiently articulated to catch aspects of reality that were not specifically considered at the time of their construction, and are too complicated to be readily tapped for significant answers, except perhaps by the most skilled operator.

Part I of this paper presents a brief review of the history of currency boards, describes their operational principles and arrangements. The introduction of the currency board in Estonia, its operation, and the institutional arrangements that were selected are described as an example of where this institution is being used successfully by a developing country. The implication for policy, the markets and the program design are also discussed.

Part II of the paper is devoted to a review of the literature discussing the monetary approach to the balance of payments and the Polak model in particular. This section also discusses the assumptions of the Polak model, the version of this model for developing countries, the economic data used to conduct the empirical studies done by J. Polak and his colleagues in International Monetary Fund, and the conclusions they have reached.

Part III determines the coefficients v and m obtained by applying the Polak model to eight countries of Eastern Europe including republics of the former Soviet Union, in the period

from 1992 to 1995, and tests the hypothesis that v is expected to be higher for countries (Estonia and Lithuania in this case) using the currency board arrangements than for the countries that do not.

Because the compilation of the economic data for Estonia and majority of the countries used in the sample remains deficient, the results of the estimation should be viewed as provisional and not intending to provide a definitive study of the application of the model to any one of the countries. It is entirely probable that a more intensive study of the monetary structure and payments data for a particular country, e.g. Estonia, would lead to refinements that would improve the empirical results.

INTRODUCTION

- **What are the “Currency Boards” ? -**

A currency board issues money that is converted into a foreign reserve currency at a fixed exchange rate. This independent institution takes over the central bank's role as a sole issuer of base money. It also manages the exchange rate to keep the currency fixed in value and convertible.

The main characteristic of the currency board system is that the board stands ready to exchange domestic currency for the foreign reserve currency at a specified and fixed rate. To perform this function the board is required to hold realisable financial assets in the reserve currency at least equal to the value of the domestic currency outstanding. Hence in the currency board system there can be no fiduciary issue. The backing to the currency by foreign currencies must be at least 100 per cent. Although in principle it is the currency board that is required to convert on demand all offers of domestic or reserve currency, in practice, where there is a banking system, however elementary, it is the banks that have carried out most of the exchange business. The buying and selling rates for both currencies have a sufficient spread so that the costs of exchanges are covered. This convertibility of currencies in the currency board system does not extend directly to bank deposits or any other financial assets. If a person has a bank deposit and wishes to use the currency board to convert it to foreign currency then the deposit must be first converted into the domestic currency and then presented to the currency board.

The claims for a currency board system are many, some clearly dubious. One main claim is that the currency board system provides an annual increment of the money supply which is simply the mirror image of the surplus on the current balance of payments. If there were no

banks, or if the banks acted only as depositories for currency, and if there were no imports or exports of capital in the form of foreign currency, then this assertion would be correct. The only way in which the residents could acquire foreign currency, and so swap for domestic currency, would be through net earnings from trade. When there is a surplus on the current account the money supply grows by that amount, and when a deficit appears the money stock contracts by the value of the deficit. This one-to-one relationship was thought to provide an automatic system which ensured that monetary behaviour always moved to eliminate a deficit or a surplus.

With notes and coin as the sole form of money and with no capital imports of foreign currency this one-to-one model was clearly valid. However, with the additional elements of the bank deposits and credit the issue becomes much less clear cut. A proportional relation still holds even with a fully developed system of bank deposits acting as money and bank credit, provided first that there were no foreign capital movements, second that the banks maintained domestic currency in their reserves as a constant fraction of their deposit liabilities, and third that the public hold a constant ratio of domestic currency to bank deposits. All these fixed ratios would ensure that M1 definition of the money supply would expand proportionally, but not one-to-one with the current balance.

Once a common arrangement to effect monetary stability in the colonial territories of European powers, the currency board is making a comeback. It is particularly playing an important role as the newly emerging countries of Eastern Europe attempt to stabilize their currencies, control inflation, and bring order to their economic conditions.

In the fall of 1991, the dissolution of the former Soviet Union caused the Baltic countries to look toward currency boards as a means of bringing stability to their economic reforms and

development. In June, 1992, Estonia left the ruble area and introduced its own national currency, the kroon. It also became the first of the Baltic countries to introduce a currency board.

- **Estonia - a developing country -**

Country:	Estonia
Territory:	45,215 square kilometres (about the size of Denmark)
Population:	1.6 million people, of which 62 percent are of Estonian origin and 30 percent are Russian.
Capital:	Tallinn with a population of 0.5 million
Official language:	Estonian, belongs to the Finno-Ugric language group.

The Republic of Estonia lies on the eastern shore of the Baltic Sea and shares borders with Latvia to the south and Russia to the east. Estonia's terrain is relatively flat, with forests covering 40 percent of the territory. The most important mineral resources, which are located in the north, consist of oil-shale, phosphorite, and limestone.

Estonia's annexation by the Soviet Union in 1940 resulted in a forced and radical transformation of its economy. The period following the war was characterised by rapid industrialisation as a result of aggressive capital formation and forced labour movements -- from agriculture to industry, and from other parts of the Soviet Union (notably Russia) into Estonia. Estonia's comparatively well-developed infrastructure and skilled work force motivated central planners to establish some relatively sophisticated industries in the country. The agriculture sector was internationally competitive in the inter-war period, and Estonia became an exporter of meat, dairy, and fish products to the republics of the former Soviet Union. Finally, Estonia has been able to meet roughly half of its energy requirements from its own resources of oil-shale and to export some electricity to neighbouring republics.

As a result of its economy's higher efficiency, Estonia enjoyed the highest standard of living among the republics of the former Soviet Union, with a per capita income 40 percent above the Union average. However, its economic performance would have been better if Estonia's economy had not been constrained by the limitations of the Soviet system. The limitations of the central planning model of development became more visible during the 1980s. Between 1980 and 1989 real gross domestic product (GDP) growth rates averaged only 1 percent per annum, despite the maintenance of investment at levels between 25 and 30 percent of GDP. The technology employed in civilian industries became increasingly backward relative to the West, and the environment suffered. The Soviet authorities' gradual abandonment of the central planning in the second half of the 1980s did not produce consistent results, as it was not accompanied by the introduction of a well-functioning alternative economic system.

The movement for economic and political independence in the three Baltic countries gained momentum during the late 1980s, and finally resulted in the approval of a law on economic autonomy by the Supreme Soviet of the USSR in 1989. The law opened the way for the initiation of economic reforms in various areas, including price and wage determination, fiscal policy, and financial sector policies. The declaration of independence on August 20, 1991, was quickly followed by Soviet and international recognition of Estonian sovereignty, and has eliminated all remaining external obstacles for the transformation of Estonia's economy.

The creation of a modern banking system in Estonia has required a transformation from a mono-bank to a two-tier banking system. The two-tier system developed gradually, beginning in the late 1980s. With the Estonian currency reform and implementation of the currency board in June 1992, a major further step was taken toward ensuring a market-based system of financial intermediation.

PART I: CURRENCY BOARDS

- Historical review -

As was the common practice among the colonial regimes of Africa, Asia and the Caribbean, Great Britain introduced its “currency board” in the early 19-th century (1825 Treasury Minutes). At that time, the Treasury sought to tidy up its administration of the colonies and to introduce the new and successful home shilling into general circulation as a standard coin of the Empire, concurrent with the numerous other coins already in use, the sovereign of course being of too high a value for general circulation. More importantly, it sought to establish fixed rates of exchange throughout the very diversified colonial systems.

Their idea was simple, and revolved around payments that needed to be made to the British troops throughout the colonies. The Treasury was to ship out an initial stock of shillings, the troops were to spend it, the local merchants were to gather it in and turn it over to the local Army Command against bills on London. The Command was to pay the troops with it by re-issue, and so on indefinitely. The Treasury, by one shipment from home, plus supplementary ones as needed by the forces, was to have a permanent circulating stock in each colony and was to be saved the expense and bother of hunting up full-weight Spanish dollars and sending out a continuous flow of specie. The rate of exchange was to be fixed and the military administration simplified. The Colonies were to have a good coin convertible into gold and their anomalous systems inflation cleared up, over a period of time, as the shilling more and more established itself. After some two centuries of colonial history, the home country was to supply its own currency to its colonies instead of leaving them to shift for themselves as best as they could. The mother country, of course, would pocket the seigniorage.

Such were the beginnings of what later became known as “currency boards”.

- **The currency board and its arrangements -**

The currency board, or an Independent Currency Authority (ICA), issues and redeems domestic currency on demand against an exchange standard and back such operations through a 100 percent marginal foreign reserve cover. They also impose significant constraints on the budget of the country that operates them. When supporting institutions have been put in place, currency boards can promote price stability, foreign trade, saving, and investment.

In most countries, the management of currency is a task of the central bank. Undertaking this and other monetary tasks gives the central bank flexibility and discretion but can also breed uncertainty about its basic objectives. Many economists have advocated narrowing central bank mandates and focus only on monetary stability instead of some combination of objectives regarding inflation, real growth, and employment. One way to narrow a central bank's mandate is to delegate the issuance and redemption of currency to a separate institution, such as currency board.

Currency boards can vary from a relatively pure, "orthodox," system, where there is no central bank (Hong Kong ICA) to more hybrid schemes that retain some limited central bank functions. An orthodox ICA might issue domestic currency that is convertible into a specified foreign currency at a fixed exchange rate and back up this commitment by holding a foreign reserve cover equal to 100 percent of the currency issue. Under the hybrid ICA arrangement the currency authority, although not formally independent of the central bank, nevertheless operates autonomously (Estonian currency board). In Estonia, the outstanding stock of high powered money is fully backed by foreign reserves and legally convertible into deutsche marks

at a fixed rate. The non-ICA functions of the Bank of Estonia, such as emergency lending to commercial banks and bank supervisory licensing, are operated by separate departments.

- **Operating Principles -**

Currency boards are obligated to supply -- on demand and without limit -- the foreign currency to which the domestic currency is pegged in exchange for local currency (bank notes and, when applicable, reserve deposits of commercial banks held with the currency board); and vice versa. The currency board sets the exchange rate for these transactions.

A national currency managed by the currency board must be perceived as a reliable store of value. Otherwise, people will be unwilling to hold the currency even for transaction purposes, or such willingness may be so volatile that it destabilises goods and factor markets. It is helpful to distinguish two types of operating principles: rules for issuing and redeeming currency, and mechanisms for ensuring that a rule can and will be followed.

- *Rules for issuing and redeeming currency:*

Under the currency board arrangement, the currency board agrees to supply or redeem the domestic currency (and, if applicable, the reserve deposits) for something else that is widely regarded to have equal value. To ensure fair treatment, currency should be issued and redeemed on demand according to a pre-announced exchange schedule. Any significant asymmetry between the terms for issuance and those for redemption could be exploited by the ICA itself or outside arbitrageurs.

The exchange standard could be a directly consumable (but standardised and durable) commodity, such as gold or oil. Or it could be the foreign currency which are cheaper to

transport and hold than gold. After the gold standard was abandoned in the 1930s, the attraction of a commodity standard for small countries diminished further while the transaction cost advantage of foreign currency remained. One exchange standard that should not be used is domestic debt, whether government or commercial. Otherwise, debtors could use the currency board as a money pump, forever submitting new IOUs to draw currency. This would threaten the currency board's independence from fiscal and banking pressures.

The rules for issuance and redemption of domestic currency could be summarised as a pre-announced exchange rate schedule against a foreign currency, with full currency convertibility on demand.

- Enforcing the Rules:

For currency board to work, the following rules must be enforced:

- currency should not be issued without being paid for. This is fundamentally an administrative problem, which can be addressed through standard accounting and auditing procedures and penalization of malfeasance.
- foreign currency must be available to redeem domestic currency. This is fundamentally a problem of reserves. If 100 percent reserve cover is maintained, resources for convertibility are guaranteed and auditing is simplified.

• **Rationales for the Currency Boards -**

The reasons for establishing a currency board instead of letting foreign currency to circulate directly in the domestic economy are:

- national pride of having own currency;

- a convenient way of garnering seigniorage (difference between the interest earnings from the investment of the foreign reserves and the ICA's administrative expenses, including costs of printing bank notes and minting coins, at a stable price level). When the foreign currency circulates, seigniorage accrues to the foreign country. Profits from seigniorage beef up reserves and are periodically turned over to the government.
- to maintain stability. For a country interested in having its own currency but uncertain of its ability to undertake discretionary management of the currency, or make it acceptable in international trade and payments, a currency board may offer a shortcut to monetary stability and convertibility.
- to retain flexibility. For example, the currency board might improve control over the domestic inflation by shifting to a more stable currency as the reserve anchor, or it might change the anchor so as to promote trade and investment with a given area. Provided that shift is economically justified and the real purchasing power of the domestic currency is maintained, the change need not erode public confidence. Indeed, the availability of this option might increase public confidence in the country's economic resilience.
- the ICA could provide an administrative base for the future full-pledged central bank;
- ease to set up and run -- an important consideration in the countries where expertise in central banking is limited.

- **Policy implications -**

A currency board system narrows the authorities' options in both fiscal and monetary policies. By demanding a pre-announced amount of foreign currency for every note it

issues and offering convertibility on demand, the currency board prevents the discretionary printing of currency to cover fiscal obligations. It also precludes the surprise devaluation of existing fiscal claims on the government, such as a promise to be paid a given wage or pension, or the devaluation of outstanding government debt denominated in domestic currency.

As a result of these constraints, a currency board makes it harder to manipulate the budget recklessly and irresponsibly, and thereby enhances investor confidence. The main long-term fiscal advantage of a central bank, over a currency board, derives from the former's ability, in a world of imperfect capital markets, to inflict inflation surprises. By contrast, a currency board emits currency only passively (barring a change in the exchange rate schedule) in response to shifts in domestic money demand. The ability to surprise the public is also a disadvantage, however. More important, attempts to manipulate inflation make it more volatile and unpredictable, undermining the real economy. One of the main attractions of an orthodox currency board is that it clearly accords higher priorities to price stability and convertibility than to inflation taxes.

It is rarely the size and the urgency of a government's financing need that make credit difficult to secure. The main consideration in sovereign lending, as in most other lendings, is fear of default. The very decision to establish a currency board, by distancing the government from the mint, may encourage more responsible budget financing, which in turn might enhance a government's fiscal reputation and open doors to credit markets sooner. Of course, a currency board's restraints on discretionary monetary financing by the government are not absolutely secure. The government may simply override the currency board's charter by requiring the commercial banks to lend to the government at a favourable interest rate. This means that the commercial banks would have to hold part of their reserves in low-yielding government bonds.

In addition to the fiscal discipline, the operation of a currency board requires extra discipline from the commercial banking system. The currency board has no responsibility to convert demand deposits directly into currency because it could erode the reserve cover. Hence, in order to ensure sufficient liquidity under a currency board arrangement, the commercial banking system needs to maintain extra reserves of domestic currency, or of reserve-currency-denominated assets that are easily convertible into domestic currency. There are two possible, not necessary mutually exclusive, ways to do this efficiently:

- (i) to encourage international branch banking. However, the authorities would need to take a relatively active role in monitoring capital adequacy, setting reserve requirements, and enforcing other prudential regulations. Through an interbank market, the international banks could also supply reserve liquidity to locally owned banks.
- (ii) to establish a separate monetary agency with substantial holdings of foreign reserves and credit lines abroad to back up the commercial banks. This monetary agency can provide discount facilities, which would be subject to strict limits. The access to the window should be tightly restricted because the monetary agency cannot risk exhausting its foreign assets. Restrictions may include punitive interest rates, time limits on outstanding discounts, and requirements that repayment of the reserve borrowing by the commercial banks take precedence over new credits to customers.

The foreign reserves or established credit lines abroad allow commercial banks or the monetary agency to provide liquidity. Since discretionary monetary financing of the budget is or should be prohibited, governments must build up other reserves or credit lines to maintain fiscal flexibility. Since the currency board does not redeem demand deposits, the banking system must have ready access to extra reserves of cash or foreign assets.

- **The Money Supply Implications of a Currency Board -**

The comparison of the Accounts of the Banking System Under the Currency Board (Table 1a) and the accounts of a Central Banking System (Table 2a) below would help explaining the money supply implications of a currency board arrangement.

The two main differences between the Central Banking System and the Banking System under the Currency Board are:

1. The central bank combines the accounts of the currency board and monetary agency. This does not affect the ratio of broad to adjusted base money.
2. The central bank has an additional asset: claim on the domestic government and non-bank enterprises. As a result the ratio of broad money to foreign reserves tends to be higher for the central bank than for the currency board and monetary agency (Tables 1b and 2b).

However, the ratio of broad money to foreign reserves is higher for a central bank than for the currency board and monetary agency, because central bank base money is backed by its holdings of government and enterprise debt (*NDAMA*). If the ratio of *NDAMA* to foreign reserves at the central bank is α , then the ratio of broad money to foreign reserves is 100α percent higher for the central bank than for the currency board and monetary agency, other things being equal. If the monetary agency under the currency board arrangement were allowed to hold domestic government paper, the money multiplier formulas for the currency board arrangement would algebraically look the same as for the central bank, although the magnitudes of the parameters might differ.

Table 1a. Accounts of the Banking System Under a Currency Boards.		
<u>Institution assets</u>		<u>Liabilities</u>
	Currency Board	
Foreign Reserves (FR)		Currency held by: public (C_p) banks (C_b) monetary agency (C_{ma})
	Monetary Agency	
C_{ma}		Reserves deposited by banks (RES)
Net foreign assets (NFA_{ma})		
Reserves borrowed by banks (BOR)		
	Commercial banks	
C_b		Deposits (D)
RES		BOR
Net foreign assets (NFA_b)		
Loans and Investments (LI)		

Table 1b. Money Supply and Multiplier Formulas Under the Currency Board.	
(The relationships follow from the Table 1a, since total assets equal total liabilities.)	
$FR = C_p + C_b + C_{ma}$	
$C_{ma} + NFA_{ma} + BOR = RES$	
$C_b + RES + NFA_b + LI = D + BOR.$	
$BOR = 0$ implies no credit window, and	
$RES = BOR = 0$ implies that no monetary agency exists.	
Consolidation yields the money supply equation:	
$M = C_p + D = (c_p + 1) / (c_p + c_b + res - bor) * (FR + NFA_{ma})$ where M	
equals the money supply and the terms in the lowercase letters denote the ratios to deposits D .	

Table 2a. Accounts of a Central Banking System.		
<u>Institutional assets</u>		<u>Liabilities</u>
	Central bank	
Foreign exchange ($FR + NFA_{ma}$)		Currency ($C_p + C_b$)
Net domestic assets (NDA_{ma})		RES
BOR		
	Commercial banks	
C_b		D
RES		BOR
NFA_b		
LI		

Table 2b.	Money Supply and Multipliers Formulas for a Central Banking System.
(The relationships follow from the Table 2a,)	
and	$FR + NFAMA + NDAMA + BOR = Cp + Cb + RES,$
	$M = (cp + 1) / (cp + cb + res - bor) * (FR + NFAMA + NDAMA).$

If a country want to establish a currency board but is concerned about its ability to obtain sufficient foreign reserves, it could consider backing only a portion of the previously accumulated currency stock. Provided that the issuance is fully covered by foreign exchange, the marginal money multipliers remain the same.

Over time, the expansion and the qualitative improvement of the banking can be expected to reduce the currency-to-deposit ratio. For a given level of reserve money, the money stock will grow under the currency board arrangement or a central banking system. However, the growth mechanisms may differ in the two cases. If the monetary agency holds no domestic assets, an increase in reserve money requires an equivalent in foreign reserves through a trade surplus or foreign loans. This is typically a market-driven adjustment. By contrast, under a central banking arrangement, part of the reserve money increase is usually engineered through an administrative decision to issue new domestic credit. This discretionary authority to expand reserves, like the discretionary authority to issue currency, has inflationary potential.

- **The Implementation of the Currency Board in Estonia -**

- *Operating Principles:*

- To break away from the Soviet monobank system and introduce economic reforms Estonia, in June 1992, introduced its new currency, the kroon, under a currency board

arrangement, replacing the ruble as legal tender within the country. The currency board arrangement was chosen to provide a relatively easy way to achieve monetary stability and convertibility, control and generally support economic reforms and development.

The decision to set up a currency board involved four main issues:

- what liabilities to back -

Under the pure arrangement, like Hong Kong, where the currency board has no role in commercial bank clearing, only bank notes are backed. In Estonia, it was decided to maintain the existing system of reserve deposits. This was done to ensure that banks held precautionary balances, over and above till money, against unexpected outflows. Such deposits are the liabilities of the Bank of Estonia and are interchangeable with cash. Therefore, they would have to be backed in the same way as cash.

- how much backing to provide-

In Estonia, the primary consideration for exchange rate policy was credibility. Merely fixing the rate, however, was not sufficient; to establish full credibility, the currency needed the backing of assets with recognised value. Initially, in order to increase public confidence in its ability to honour the promise of convertibility, an Estonian currency board started with the amount of foreign reserves sufficient to cover 90 percent of the outstanding value of the kroon bank notes and reserve deposits of banks into the foreign currency at a fixed rate of exchange.

- what to back with and peg to -

The return of pre-war gold to Estonia by the Bank of International Settlements and Sweden permitted full capitalisation of the currency board, including a comfortable margin of excess reserves.

The choice of the currency to peg to depends on whether the currency is strong or weak and on the future trading relationships. In Estonia, although the Finnish markka or Swedish krona might have recommended themselves from the point of view of trade, the deutsche mark was chosen because of its strength.

The Estonian kroon was fixed at EEK 8 per DM1, and the base money supply was fully backed by foreign reserves, initially by gold, but soon afterward by interest-bearing deutsche mark assets. The confidence in the new Estonian currencies and their adopted stabilisation policies was reflected in the developments of the exchange rates and foreign reserves.

- who should have access to the board-

Under the Estonia's currency board arrangement, banks have direct recourse to the Bank of Estonia and can exchange DM for EEK and vice versa. In order to demonstrate to the general public that this guaranteed exchange was genuine, the central bank provided a window to convert bank notes into deutsche marks and vice versa to all comers. Other transactions were settled via account.

A currency board could reduce its own handling costs by refusing small-scale transactions and by not dealing directly in the currency of the reserve country. Commercial banks would be left to aggregate purchases and sales of the reserve currency and to cash reserve currency check.

- Institutional arrangements:

To distinguish between the operation of the currency board and employment of foreign exchange reserves in excess of the currency board cover, the operation of the Bank of Estonia were divided into two departments: the Issue Department and the Banking Department. The

Issue Department's balance sheet, which represents the currency board, contains as liabilities all kroon bank notes and banks' reserve deposits with the Bank of Estonia, and as assets the foreign exchange necessary to match this liabilities. The Banking Department contains all the surplus foreign exchange and -- if some of these reserves have been used at any point in time for emergency loans to troubled banks -- kroon loans to the banking system. These assets of the Banking Department are matched on the liability side by the Bank's capital. The Banking Department will undertake technical central banking functions, and if a well-considered emergency need arises, it may provide limited and temporary liquidity assistance to the commercial banks.

BANK OF ESTONIA

ISSUE DEPARTMENT		BANKING DEPARTMENT	
Operates the currency board		Holds excess foreign exchange reserves.	
<u>Assets</u>	<u>Liabilities</u>	<u>Assets</u>	<u>Liabilities</u>
Foreign exchange Seigniorage, in the form of interest earned, is passed, as it accrues, to the Banking Department.	Bank notes and deposits in kroon placed with the Bank of Estonia.	Surplus foreign exchange Kroon loans to the banking system.	Bank's Capital

The Issue Department balance sheet is endogenous to the economy at large - it is not controlled by the authorities. The Banking Department represents the exogenous, or policy side

of the central bank and as such it is very important to be able to distinguish these activities from those of the Issue Department.

The division of responsibilities serves to ensure that, whatever assistance the Bank of Estonia chooses to give to the banking system, it cannot exceed its surplus foreign exchange reserves and therefore cannot compromise the currency board.

- Policy implications:

The Bank of Estonia (BOE) does not lend to the Government or to enterprises. Since the Government cannot obtain financing from the central bank, this means that other sources of financing are needed. Because of the difficulties faced by banks in Estonia, there were few resources to lend even to the private sector. As a result, Estonian authorities were forced to implement a tight fiscal policy in order to accommodate the size of the government sector and facilitate the transition to a market environment. The commitment to balance the budget was met in 1992, and was a key factor in the success of the new currency. Fiscal operations have continued to generate a fiscal surplus and a build-up of government deposits in the banking system.

The BOE also does not interfere with the setting of interest rates by the commercial banks, since this is one of the principal mechanisms by which the currency board arrangement is intended to maintain equilibrium in the money and foreign exchange markets. By foregoing the ability to control interest rates, however, the authorities gain a more robust exchange rate. This is because the attempts to control interest rates through open market operations lead to changes in the reserves. Under a currency board, open market operations are not permitted, and this process of reserve depletion is thereby ruled out.

Due to a lack of viability and the lack of full confidence of the public in the banking system prior to restructuring, and to prevent the transfer of funds abroad, thereby protecting the liquidity of the banking system as a whole, the Estonia currency board was set up with a system of capital control. This system required the surrender of foreign exchange earnings to authorised commercial banks and precluded the purchase of foreign exchange with kroon for anything other than current transactions. For personal transactions, purchases of foreign exchange required proof of travel or other current account need.

- Implications for the program design:

The implementation of the currency board arrangement demanded some changes to the usual performance criterias used by the International Monetary Fund. Particularly, it did not make sense to target the currency board's reserve holdings. The fact that the currency board's balance sheet is effectively determined by the demand for cash means that the reserve employed to back the note issue are not under the control of the authorities. Targets can be retained for the reserves that are under the direct control of the authorities. In particular, the reserves that are surplus to the requirements of the currency board, i.e. reserves of the Banking Department. Since these reserves are to be used, in exceptional circumstances, for the purpose of supporting banks, a reserve target of this type serves also as a ceiling on the central bank net domestic assets. Therefore, there is no need for a separate performance criterion for the net domestic assets. The confidence in the new Estonian currencies and their adopted stabilisation policies was reflected in the developments of the exchange rates and foreign reserves. Estonia's nominal exchange rate began to appreciate against the ruble immediately after the currency reform, and against the US dollar it moved in line with the deutsche mark/dollar cross rate,

given the deutsche mark peg. As an indication of confidence in the fixed rate regime, foreign reserves began to accumulate rapidly. While the high level of foreign direct investment in Estonia relative to Latvia and Lithuania may partly reflect credibility considerations, it surely is owing also to Estonia's closer historical, political, and cultural links to Finland and Sweden, the major foreign investors in Estonia.

- Review of the first few years of operations:

Estonia has made significant progress in its macroeconomic stabilisation. Its experience highlights several factors, partly general and partly specific, which made their transition process successful so far. In fact, during the first two-to-three years into serious reform, inflation has fallen. Within the same period, the output cost of this disinflation process has remained small. There is a little doubt that one of the key explanations for this has been the Estonian authorities' apparent and early determination to take rapid action to liberalise the economy and adopt strong stabilisation policies, an attitude enhanced by the political events in the late 1980s and early 1990s before they regained their independence.

There have been several specific factors that help explain the Estonian success in stabilisation. Solid fiscal positions throughout 1992-94 helped establish the credibility of strong monetary policies. In light of the Estonian experience, the choice of such a regime may not make a significant difference in terms of bringing down inflation. The appreciation of the real exchange rate, which has continued since the outset of the reform, has thus far been sustainable, and there are signs that the recovery of output that is taking place is also sustainable.

PART II: THE POLAK MODEL

- The Monetary Approach to the Balance of Payments-

The view that the balance of payments is essentially a monetary phenomenon gained widespread popularity during the 1960s and 1970s. The monetary approach contains at least two basic insights into the balance of payments analysis:

- 1) the balance of payments position of a country reflects decisions on the part of its residents to accumulate or run down their stock of money balances. It is this process of monetary adjustment that gives rise to the balance of payments surpluses and deficits.

- 2) in an open economy operating under fixed exchange rates, the money supply is not controlled by the monetary authorities; it is the domestic component of the monetary base (domestic credit) that is relevant monetary policy variable, rather than the overall monetary base, since the latter is an endogenous variable responding to changes in international reserves.

Over the years the International Monetary Fund has endeavoured to develop various models that would indicate, in only an approximate way, the likely relationship between the credit creation in a member country and its balance of payments. One characteristic of this effort at model building has been that it has aimed at simple models. The advantage of simple models, if they are well designed, is that they will bring out clearly the main relevant features and interrelationships of a particular economy and thus point to certain major relationships important for policy purposes. More refined models may take into account a much wider set of variables and relationships, and may thus, in principle, serve to answer a wider variety of questions over a broader range of circumstances; but in practice such models often fall between two stools, being at the same time insufficiently articulated to catch aspects of reality that were not specifically considered at the time of their construction and too complicated to be readily

tapped for significant answers, except perhaps by the most skilled operator. One model emerged that virtually met all these criteria. It became known as the Polak model.

- **The Polak Model -**

Jacques Polak was a pioneer in the development of the monetary approach in the International Monetary Fund (IMF). In his approach Polak integrated monetary and credit factors into balance of payments analysis and derived a formal relationship between policy measures and balance of payments outcomes. The framework he developed, which is incorporated in a set of balance sheets and behavioural relationships linking assets and liabilities of the banking system to the balance of payments, yielded a unique relationship between changes in domestic credit and changes in international reserves. This framework could be used for setting policy. Many years after Polak's paper was published, almost all IMF-supported adjustment programs still exploit this key linkage between domestic credit and the balance of payments and still employ the domestic credit ceiling as a performance criterion.

In 1957 Polak published his classic paper, "Monetary Analysis of Income Formation and Payments Problems," which contained the simple framework now known as the "Polak Model". This model provides a theoretically elegant, but also eminently practical, answers to the pressing issue of how to calculate the rate of domestic credit creation consistent with a targeted improvement in the balance of payments. The model contains two behavioural relationships: an import demand function and a quantity theory of money equation designed to explain nominal income. Two identities, for the balance of payments (equal to exports minus imports plus net capital flows, Table 3) and for the money supply (equal to domestic credit of the banking system

and the domestic currency value of net international reserves, Table 4), are used to close the system.

Table 3 Schematic Representation of the Balance of Payments

<i>Accounts and Sub-Accounts</i>	<i>Cumulative Balances</i>
Current Account (X-M)	
Merchandise.....	Merchandise balance
Services	
• tourism	
• transportation	
• professional and other services	“resource transfer”
Investment income	Balance on goods, services, and income
Unilateral transfers	
• government grants	
• private remittances	Current account balance
Private Capital Account (CF)	
Direct Investment	
Portfolio investments (securities and banking flows)	
• long-term	Basic balance
• short-term	Overall balance of payments
Official Reserve Transactions (ORT)	
Changes in foreign central banks’ holdings of domestic assets	
Changes in domestic central banks’ holdings of foreign assets	
• gold	
• IMF credits and SDRs	
• foreign exchange reserves	

Each balance at the right is the sum of the previous balance and the additional items listed before the dotted line.

How the model works-

To illustrate how the Polak model works, consider the case of a temporary expansion in domestic credit (ex. Government securities). The increase in domestic credit initially raises the money supply, and from the quantity theory of money relationship, nominal income raises. However, the increase in nominal income causes imports to increase, and given exports and net

capital flows, the balance of payments worsens. The resulting fall in international reserves pushes the money supply down, and the process is reversed. In the long run, the expansion in domestic credit is matched by a loss of international reserves.

This one-for-one relationship between changes in domestic credit and international reserves is the fundamental equation of the monetary approach to the balance of payments.

This is a short-term model used by IMF to evaluate the performance/progress of developing countries.

Table 4 Simplified Balance Sheet of the Central Bank

<u>Assets</u>	<u>Liabilities</u>
Government Securities (Domestic Credit)	Notes in Circulation
Foreign Currency Assets (Foreign Currency Reserves)	Chartered Banks Deposits
<u>Total Assets</u>	<u>Total Liabilities</u>
DC + Res	Monetary Base

- Assumptions of the Model:

J.Marcus Fleming and L.Boissonneault in their "Money Supply and Imports" article have summarised the principal assumptions of the Polak model.

The principal assumptions of the model are:

1. the velocity of money (v) is constant and different from zero

$$Y = v * MS$$

Since, v is constant, the rate of interest (I) is irrelevant in the resource allocation.

Letting $v = 1/k$ and $k = 1/v$, where k is the coefficient of the demand for money

$$MS = k * Y, \text{ and } 0 < k < 1$$

2. a constant relationship between money imports and money income (i.e., in some cases a constant *average*, in others a constant *marginal* propensity to import in terms of money);

$$MPM = APM$$

3. the money coming into existence as the counterpart of domestic credit expansion and of capital imports (as well as that coming into existence as the counterpart of exports) enters immediately into income and is successively re-spent at the end of each subsequent income period ;
4. the value of exports, net capital imports, and domestic credit expansion may be taken as independent variables and the value of imports as dependent variable.
5. the exchange rate is fixed. This implies that there is no devaluation to correct the deficit in a short run.

On the assumptions of the model, imports will tend to equal gross money creation after a distributed time lag, and variations in credit expansion, which is regarded as a policy variable, will exercise a predictable and potentially controlling effect on the balance of payments.

- **Polak Model for Developing Countries -**

In their 1971 paper "Credit Policy and the Balance of Payments" J.J. Polak and Victor Argy, presented the two separate versions of the 1957 model, for developed and developing countries.

In models for developing countries it is reasonable to assume that there is little organised capital market, that credit is rationed, that holdings of money are predominantly transactions

balances and insensitive to interest rates, that capital flows are largely autonomous, and that the money supply tends to respond to the overseas balances. Moreover, lack of data in these countries makes it difficult to test hypothesis with any degree of refinement. Given these conditions, the following model was developed:

Notation used: Y = gross national product

MS = money supply

X = exports

M = imports

CF = net capital inflow of the non-banking sector

Res = Reserves = change in the net overseas assets of the banking system (central bank and commercial banks)

DC = total domestic credit of the banking system

Exogenous variables: $X(t)$ - exports $CF(t)$ - net inflow of capital

$DC(t)$ - domestic credit $VE(t) = X + CF + DC$

Endogenous variables: $M(t)$ - imports

$Y(t)$ - income

$MS(t)$ - money supply

Model for Developing Countries

(1) $Y = v * MS$, where $v=1/k$ and $0 < k < 1$

(2) $M = m * Y$, where $0 < m < 1$

(3) $\Delta MS = \Delta Res + \Delta DC$

(4) $Res = X - M + CF$

Equations (1) and (2) are the two behavioural equations in the model, the first reflecting the constant velocity assumption and the second explaining imports in terms of income.

Equations (3) and (4) are identities, the first of these showing that the increase in the money supply is partly of foreign origin (Res) and partly of domestic origin (ΔDC), and the second identifying the components of the balance of payments.

For reasons of simplicity, this model makes no explicit allowance for reaction lags. The dynamic character of the model derives from the fact that it contains both MS and ΔMS . There is an implicit lag in equation (1), income being a flow during a period and money a stock at the end of that period.

These equations may be combined to yield solutions in discrete time periods for income and the change in net foreign assets of the banking system.

$$(5) \quad Res = 1 / (1+m*v) * \Delta(CF + X) - m*v / (1+m*v) * \Delta DC + 1 / (1+m*v) * Res(t-1)$$

$$(6) \quad \Delta Y = v / (1+m*v) * \Delta(CF+X) + v / (1+m*v) * \Delta DC + v / (1+m*v) * Res(t-1)$$

The time period is treated as one year.

The above equations show the first-period effects on the balance of payments and income of changes in the exogenous variables in the model (CF, X, DC), e.g., a unit increase in domestic credit will reduce the net overseas assets of the banking system in the period by $mv / (1+mv)$. This short-term solution satisfies the behavioural equations in the model but it need not entail equilibrium in the balance of payments, which requires that $Res = Res(t-1)$ and hence also that $\Delta Y = \Delta Y(t-1)$. The long-run solutions that satisfy these conditions are

$$(7) \quad Res = 1 / m*v * \Delta(CF + X) - \Delta DC$$

$$(8) \quad \Delta Y = 1/m * \Delta(X+CF)$$

We will assume that changes in the exogenous variables are once for all, i.e., that exports, net capital flows, or credit all rise or fall to a new level that is then maintained in

subsequent periods. In these conditions the coefficients in the long-run solution is the sum of all the effects in the individual periods on the balance of payments and the change in income, e.g., a coefficient of $1/mv$ in equation (7) indicates the sum of the balance of payments surpluses resulting from a once-for-all increase in a unit of capital inflow or exports.

Reduced form:

- $\hat{M}(t) = 1 * \hat{VE}(t)$
- $\hat{Y}(t) = 1/m * \hat{VE}(t)$
- $\hat{MS}(t) = k/m * \hat{VE}(t) = (1/v * m) * \hat{VE}(t)$

- Description of the Data and Estimation Procedures:

In a joint 1960 paper “Monetary Analysis of Income and Imports and Its Statistical Application” Jacques Polak and Lorette Boissonneault have done the extensive empirical tests of the Polak model, and provided separate tables and charts for each of 39 subject countries. I will use their article as a guide for the sources, and description of the data, as well as the techniques and methods used to estimate the Polak model for a developing country which is utilising the currency board. In this case it is Estonia. The data that will be used to estimate the coefficients of this Polak model is collected and organised in the following manner:

(i) Balance of Payments data is divided into four categories, which are called:

- Export Receipts;
- Imports Payments;
- Capital movements;
- Reserve movements.

All items are expressed in a country's own currency.

Export receipts cover:

- receipts from merchandise exports, including military aid;
- any credit entry for non-monetary gold;
- net investment income (for most countries a negative item);
- gross receipts from other services, including military aid services;
- private donations received.

Import payments cover:

- payments for merchandise imports;
- any debit entry for non-monetary gold;
- payments for services (excludes investment income payments);
- private donations extended.

Capital movements cover all items in the balance of payments that are not included in the two preceding categories or in reserve movements.

- official donations;
- the net movement of private capital;
- the net movement of official and banking assets and liabilities other than reserve movements;
- errors and omissions.

Reserve movements: By the definition used, Export Payments plus Capital Movements minus Import Payments equal Reserve Movements (eq.4). Figures for changes in reserves are arrived at by adding balance of payments data for official and bank's short-term assets, short-term liabilities, and monetary gold.

(ii) Monetary Data

The monetary balance sheet implied in equation (3) (see pg. 7)

$\Delta MS(t) = \Delta Res(t) + \Delta DC(t)$, where Res = an increase in net foreign assets,

DC = an increase in net domestic assets

contains two domestic variables: money and net credit creation. Since net credit creation is arrived at by subtracting the increase in non-monetary liabilities from gross credit creation, the definitions of net credit creation and of money are interrelated. A narrow definition of money, which for most countries does not include time or savings deposits, is the definition used in the IMF's publication, «International Financial Statistics» (IFS). By equation (3), net credit creation equals the increase in money less the increase in net foreign assets. To assure agreement with the balance of payments data, net credit creation is measured by subtracting the change in foreign assets based on balance of payments statistics from the change in money.

- *Statistical Testing:*

The Polak model can be tested statistically in two ways.

One way is to obtain estimates of velocity and the marginal propensity to import from data for a number of years. These estimates are used to calculate a priori coefficients attaching to the exogenous variables. These coefficients are then applied to data for the exogenous variables, and predictions for imports and income are obtained for each year. These predictions are then compared with the actual values for imports and income.

A second way is to directly regress the dependent variables in the model (imports, income) against the independent variables (exports, net capital flows, and credit) in current and past years. The result of these tests, for both the developing and the developed countries, have been good. On the whole, imports and income have been explained well by this model.

Given the two behavioural equations in this model, it follows that one would expect the model to perform better, the smaller the variability in the import and velocity functions. Studies within the International Monetary Fund have shown that these functions tend to be

more unstable for the less developed countries; hence, this model should really give worse results for the latter group of countries. But this greater variability in the less developed countries is due to reasons that are difficult to incorporate formally in models, e.g., for imports, the greater variability in the use of controls and duties, and for velocity the greater instability (political, social, economic) and - more important - the much larger variation in the non-monetary (barter) sector.

- Conclusions of the Model:

J.Marcus Fleming and L.Boissonneault in their paper « Money Supply and Imports » after examining the data relating to 36 countries over a period running in general from 1950 to 1958, have come to the following conclusions;

- (1) In the average country, there is a moderately good correlation between deviations from the trend in actual imports and the corresponding deviations in estimated imports as computed on the basis of the model. The correlation appears to be better in primary producing countries.
- (2) The correlation between imports and the stock of money - which ought, on the assumptions of the model to be close - is substantially poorer in most countries than that between imports and "computed imports".
- (3) On the other hand, the correlation between imports and gross money creation in the same year is considerably better than that between imports and computed imports which, as already observed, is simply gross money creation with a distributed time lag.

- (4) This finding implies that there are import variations, not allowed for in the model, which are closely associated with variations in gross money creation.
- (5) The superiority of gross money creation over computed imports as a correlate of actual imports is not attributable to any tendency for gross money creation to be associated with a speeding up in the velocity of circulation of money, but is largely attributable to a tendency for the relationship of imports to income to vary with variations in gross money creation.

PART III: EMPIRICAL ANALYSIS

- Estimation of the panel data -

The purpose of this part is to estimate the parameters m and v , multipliers and to make predictions of the variables Y and M_s .

The estimation of the Polak model is done using the panel data for 8 countries (Estonia, Latvia, Lithuania, Ukraine, Czech Republic, Hungary, Slovak Republic and Poland) during the period of 4 years (see appendix). A number of countries have been omitted in the estimation either because certain essential series were missing or were not available in continuity for a sufficient number of years, or because balance of payments figures that are reported to the Fund in dollars could not, on account of exchange rate problems, be converted into local currency

Panel data provides repeated observations on the cross-section of 8 countries. The main advantages of panel data are the possibilities of controlling for unobservable heterogeneity across countries and modelling dynamic responses from only a small number of time series observations. On the other hand, the main limitations include the danger of amplifying measurement error problems, and that the sample can become unrepresentative over time due to attrition.

The simplest and most intuitive way to account for differences in behaviour of different countries, in the context of a panel data regression problem, is to assume that some of the regression coefficients are allowed to vary across countries. The introduction of the dummy variables is one of the ways to capture qualitative characteristics within the economic model. The dummy variables take just two values, usually 1 or 0, to indicate the presence or absence of a characteristic. That is a dummy variable D is

$D_N = 1$ is the characteristic is present (i.e. country is utilising the currency board)

$D_N = 0$ if the characteristic is not present.

Therefore, a dummy variable incorporated into the model captures the effect of the presence of a currency board by developing countries (Estonia and Lithuania) on the two coefficients to be estimated, income velocity of money (v) and marginal propensity to import MPM (m).

A priori, country utilising a currency board is expected to have a higher income velocity of money coefficient (v) because of the tight monetary policies (by controlling the expansion of domestic credit). The size of the marginal propensity to import (m) is expected to be higher because stable national currency and low inflation will promote trade with other countries.

- The Statistical Model:

A model that allows its parameters to vary in one or two dimensions is known as a fixed effect model (or fixed coefficient model). This model of parameter variation specifies that the intercept and slope parameters vary only across countries and not over time.

Given a panel sample of $N=8$ countries over $T=4$ periods, the basic linear regression equation takes the form:

$$\begin{aligned}
 Y_{(it)} &= b_{(1)} + b_{(2)} * X_{(2it)} + b_{(3)} * X_{(3it)} + e_{(it)} & i = 1, \dots, N \quad t = 1, \dots, T \\
 &= b_{(1it)} + \underline{b}'_{(it)} * \underline{X}'_{(it)} + e_{(it)} & (1)
 \end{aligned}$$

where

$Y_{(it)}$ is the observation on the dependent variable (for country i at time t),

$\underline{X}'_{(it)}$ is the $(K-1)$ row vector of the explanatory variables, $e_{(it)}$ is a non-observable random term,

\underline{b}' is the $(K-1)$ column vector of the slope parameters and $b_{(1)}$ is the intercept.

When different intercepts are permitted for the N countries/individuals, the model becomes:

$$\underline{Y}_i = \underline{1}_T b_i + X_i \underline{b} + e_i \quad (2)$$

where

\underline{Y}_i is the $T \times 1$ vector of the $Y_{(it)}$,

$\underline{1}_T$ is the unit vector of size T ,

X_i is the $T \times (K-1)$ matrix whose t -th row is $\underline{X}'_{(it)}$

and e_i is the $T \times 1$ vector of errors.

The expression (2) can be rewritten in a simpler form

$$\underline{Y} = D_N \underline{b}_1 + X \underline{b} + e \quad (3)$$

where D_N is the matrix containing a set of N individual dummies.

$D = 1$ if N is a particular country

$D = 0$ otherwise.

The intercept dummy measures the intercept coefficient (i.e. a constant) applicable to the particular country. In other words it represents this country's "autonomous" imports. The slope dummies allow to test the hypothesis that slope coefficients (in this case m and v) are different for each country and both v and m are higher for a country utilising the currency board.

Expression (3) represents the basic covariance model (in the case of individual effects only), and has the following assumptions:

- the errors $e_{(it)}$ are independent and distributed $N(0, \sigma^2)$ for all N and T .
- the explanatory variables are non-stochastic, independent of the errors, such that the $NT \times (N+K-1)$ matrix $[D_N X]$ has full column rank.

Given the above assumptions, the OLS estimators of \underline{b}_i and \underline{b} in model (3) are BLUE and under the normality assumption, the usual t-tests and F-tests can be permitted. In particular, to test the hypothesis $b_i=b_j$ ($i \neq j$) against the alternative $b_i \neq b_j$ the calculated t-ratio is distributed, under the null hypothesis, as a t-variable with $NT-N-K+1$ degrees of freedom.

• **Macroeconomic results and commentaries -**

- *Estimation method I:*

One of the methods proposed by J.Polak and L. Boissoneault to obtain estimates of:

- income velocity of money v is by dividing the figures for Gross Domestic Product (Y) by the figures for money for a number of years, i.e. Y/MS

- marginal propensity to import m is calculated by dividing import payments by GDP for the same year, i.e. MS/Y and then taking the average for the period. The Table 5 below shows the v and m obtained by using this method.

Table 5 Estimation of v and m

Year	$k=1/v$	$v=\hat{Y}/\hat{Ms}$	$m=\hat{Y}/\hat{M}$	Year	$k=1/v$	$v=\hat{Y}/\hat{Ms}$	$m=\hat{Y}/\hat{M}$
Estonia				Lithuania			
1993	0.2734	3.658	0.8655	1993	0.865	11.5567	0.1229
1994	0.1207	8.2834	0.9154	1994	0.0423	23.6528	0.1653
1995	0.1784	5.6052	0.8634	1995	0.1506	6.6389	0.7534
Average	0.1908	5.2401	0.8814	Average	0.0931	10.7359	0.3472
Latvia				Ukraine			
1993	0.00001	21761.02	0.1785	1993	0.23	4.3481	0.6601
1994	0.0001	6905.82	0.2428	1994	0.1444	6.9249	0.0051
1995	0.00001	120037.74	0.9163	1995	5.8999	0.1695	1.6853
Average	0.0001	15068	0.4459	Average	2.0914	0.4781	0.7835
Czech Republic				Slovak Republic			
1993	0.0001	11293.53	0.0702	1993	0.3153	3.172	0.8359
1994	0.0011	940	0.2108	1994	0.1009	9.9098	0.1395
1995	0.0001	7915.9	1.2242	1995	0.3369	2.9686	0.6591
Average	0.0004	2346.13	0.5017	Average	3.9839	3.9839	0.5449

Hungary				Poland			
1993	0.0001	7904.26	0.7378	1993	0.1147	8.7201	0.4274
1994	0.0001	9698.27	0.1458	1994	0.1429	6.996	0.2474
1995	0.0001	14187.45	1.87	1995	0.7911	1.2641	1.4567
Average	0.0001	9996.33	0.9179	Average	0.3496	2.8607	0.7105

(i) Interpretation of the coefficient m :

The marginal propensity to import m for Estonia during the studied period varied from 0.8634 to 0.9154. It stays relatively stable and very high. This supports the initial hypothesis that m is expected to be greater for a country utilising the currency board arrangement, such as Estonia. Among the countries used in the sample only Hungary has a higher m , but it is extremely volatile (one of the estimates is greater than 1, which is against the assumption $0 < m < 1$). The analysis of estimate of m for Lithuania supports the initial assumption as well. Its marginal propensity to import during the studied period varies from 0.1229 to 0.7534, with the highest $m=0.7534$ in the first year following the implementation of the currency board in Lithuania.

The other countries in the sample are showing the different degrees of fluctuations in their marginal propensities to import. Some of the coefficients m are greater than 1. This could be due to the quality of data used in the estimation. The quality of data is a common problem for the developing countries, especially for the former republics of the Soviet Union, which are experiencing many shocks during their period of transitions from a planned to a market economy. In general, the results so far support the initial hypothesis that countries utilising the currency board should exhibit a higher marginal propensity to import, because the stable national currency and credibility of the monetary authorities will result in a stronger and low inflation economy and consequently promote trade with the rest of the world.

(ii) Interpretation of the coefficient v :

The income velocity of money v for Estonia during the period of 1992 to 1995 varies from 3.658 to 8.2834 with the average for the period of 5.2401. The estimated v for Lithuania fluctuates from 6.6389 to 11.5567 and the average for the period is 10.7359. The huge fluctuation in coefficients, which peak in 1994 for both countries, is a result of banking crisis that took place in 1994 in all Baltic countries.

The income velocity of money v for other countries in the sample is even more volatile. Disregarding the estimated v values for Latvia, Czech Republic and Hungary which are suspect due to the unreliable data emanating from Eastern Europe and former Soviet Union the remaining estimated values of v are consistent with the initial hypothesis, i.e. that the coefficient of income velocity of money is higher for countries utilising the currency boards than for the countries utilising other arrangements.

In addition, the relative stability of the estimated coefficient v for Estonia tends to support one of the main assumptions of the Polak model - that the income velocity of money is constant.

- *Estimation method II:*

The second estimation method proposed is by regression. Here the combination of the cross-sectional and time-series data is used. The slope dummy variables enable us to estimate the coefficients v and m for each country individually. The results obtained are presented in Table 6 below.

Table 6 Regression Estimation Results

Coefficient	$M=M_N+m_N*Y$	$Y=Ms_N+UN*Ms$	Coefficient
$m_{Curr.board}$	0.56309	1.2197	$V_{Curr.board}$
	(3.138)*	(4.639)*	
$M_{curr.board}$	4.1062	-0.24650	$MS_{Curr.board}$
	(2.349)*	(-0.1145)	
M_{Latvia}	4.1527	9.7628	MS_{Latvia}
	(1.005)	(6.517)*	
m_{Latvia}	0.20507	1.74952	V_{Latvia}
	(0.3499)	(0.5929)	
$M_{Ukraine}$	0.55663	0.82757	$MS_{Ukraine}$
	(0.8691)	(1.312)	
$m_{Ukraine}$	0.18607	-0.14494	$V_{Ukraine}$
	(0.9435)	(-0.5176)	
$M_{Czech Rep.}$	14.785	26.742	$MS_{Czech Rep.}$
	(4.997)*	(7.122)*	
$m_{Czech Rep.}$	0.67045	3.3706	$V_{Czech Rep.}$
	(2.459)*	(4.791)*	
$M_{Hungary}$	-7.7982	0.82517	$MS_{Hungary}$
	(-0.5641)	(0.05818)	
$m_{Hungary}$	0.90157	1.90987	$V_{Hungary}$
	(0.9708)	(0.4288)	
$M_{Slovak Rep.}$	6.8407	-2.2240	$MS_{Slovak Rep.}$
	(0.4583)	(-0.1140)	
$m_{Slovak Rep.}$	0.12444	1.072723	$V_{Slovak Rep.}$
	(0.1065)	(0.04317)	
M_{Poland}	-4.3048	4.6212	MS_{Poland}
	(-0.5147)	(0.7973)	
m_{Poland}	0.70953	2.48195	V_{Poland}
	(0.9895)	(0.7616)	
D.F.	18	18	
R²	99.07	98.97	
R²adj	98.4	98.23	
DW	2.8101	2.6521	

Values in parentheses are the corresponding t-statistics, that is, coefficient divided by its standard error. An asterisk denotes the statistically significant coefficients (95 percent confidence interval and 18 degrees of freedom).

(i) Interpretation of the results

Both regressions show very high goodness of fit coefficients R^2 and $R^2_{adjusted}$. In the first equation they are 0.9907 and 0.984 respectively. This means that 98.4 percent of variation of the dependant variable M (imports) are explained by the variation in the independent variable Y (national income). At the same time only four out of 14 estimated coefficients are statistically significant due to data issues mentioned earlier. The marginal propensity to import for Estonia and Lithuania (both operating currency boards) is 0.56309 and is statistically significant at 95 percent confidence interval. Thus the estimated equation for these countries which utilise the currency board is:

$$M = 4.1062 + 0.56309 * Y, \quad R^2 = 0.9907 \quad R^2_{adj} = 0.984 \quad Durbin-Watson = 2.81$$

Among the other countries in the sample only Slovak Republic has a statistically significant estimated coefficient of marginal propensity to import.

$$M = 14.785 + 0.67045 * Y, \quad R^2 = 0.9907 \quad R^2_{adj} = 0.984 \quad DW = 2.8101$$

All the other countries in the sample have estimated coefficients of the marginal propensity to import not statistically significant from zero. The fact that majority of the coefficients are not statistically different from zero and that the regression has an exaggerated goodness of fit could be explained by the presence of serial correlation (or autocorrelation). Autocorrelation is quite common for a time-series. Two of the sources of the autocorrelation are measurement errors and purely random unpredictable effects. Both sources are possible in the sample using the data for developing countries.

Overall, the results obtained by regression are inconclusive and thus the initial hypothesis that a country utilising a currency board is expected to have higher marginal

propensity to import cannot be supported by results obtained from the estimating by regression.

The analysis of the estimates, obtained by regression, of the coefficient of income velocity of money are: both $R^2=0.9897$ and $R^2_{adj}=0.9823$ are very high. This implies that 98 percent of variation in a country's income Y are explained by the variations in the country's money supply M_s . For Estonia and Lithuania the estimated coefficients are

$$Y = -0.24650 + 1.2197 * M_s \quad R^2 = 0.9897 \quad R^2_{adj} = 0.9823 \quad DW = 2.6521$$

Thus, the estimated coefficient of the income velocity of money v is statistically significant from zero at 95 percent confidence level. There is only one other country in the whole sample which has a statistically significant estimated coefficient of v . This is Czech Republic. The estimated coefficients for Czech Republic are

$$Y = 26.742 + 3.3706 * M_s \quad R^2 = 0.9897 \quad R^2_{adj} = 0.9823 \quad DW = 2.6521$$

As before, among the 14 estimated coefficients only 4 are statistically significant. One of the estimated coefficients v (Ukraine) has a negative value. Thus we have the same problem of present autocorrelation as for the coefficient m .

The findings of the estimation by regression are inconclusive and cannot support the initial hypothesis of a higher income velocity of money for a country operating a currency board.

The earlier studies within the International Monetary Fund have shown that both of the these estimated functions tend to be more unstable for the less developed countries (see Part II). As a result, this model usually gives worse results for this group of countries.

The comparison of the results obtained by two different methods are presented in the table 7.

Table 7 Comparison of estimated of v and m

COUNTRY	METHOD I		METHOD II	
	v	m	v	m
ESTONIA	5.2401	0.8814	1.2197	0.56309
LITHUANIA	10.7359	0.3472	1.2197	0.56309
LATVIA	15068	0.4459	1.74952	0.20507
UKRAINE	0.4781	0.7835	-0.14494	0.18607
CZECH REPUBLIC	2346.13	0.5017	3.3706	0.67045
HUNGARY	9996.33	0.9179	1.90987	0.90157
SLOVAK REPUBLIC	3.9839	0.5449	1.072723	0.12444
POLAND	2.8607	0.7105	2.48195	0.70953

The coefficient v of income velocity of money for Estonia obtained by method I is almost twice as large as one estimated by regression (method II). The same coefficient v for Lithuania using the two methods is 10.7359 and 1.2197 respectively. In case of Latvia $v(I)=15068$ is extremely high and, from the theoretical point of view, does not make any sense. At the same time $v(II)$ for Latvia is 1.74952 and is more plausible. For all three countries the estimates obtained by method I seem to be more real and acceptable. Such ambiguous results can be explained by the fact that all the Baltic countries in the above sample had experienced banking crises during this time interval. The consequences of this crises are reflected in the estimated coefficients.

The estimated coefficients m , marginal propensity to import, for Estonia, Lithuania and Latvia fluctuate less and are more stable. All of the coefficients estimated by both methods fall onto the interval from 0 to 1. Estonia and Lithuania have a higher m than Latvia obtained by the method II. This supports the initial assumption of a larger m for countries utilising currency boards. At the same time, the estimate of m obtained by method I is the highest for Estonia followed by Latvia and Lithuania accordingly.

So far, the results obtained by the method I appear to more realistic than the results obtained by method II but more extensive empirical studies have to be done.

- *Predictions:*

This section presents the prediction results obtained by applying the estimated coefficients of marginal propensity to import and income velocity of money calculated by both methods to the data of domestic credit. Such predictions could help answer questions concerning the effects of a specified monetary changes on income or on the balance of payments. The table below shows the obtained results. Computed money supply is obtained by applying the coefficient $1/(v*m)$ to the variable DC . Computed income is estimated by applying coefficients $1/m$ to the exogenous variable DC .

Table 8 **PREDICTIONS (by method I)**

$$\hat{M}_{spred} = 1/(v*m)*\hat{DC}$$

$$\hat{Y}_{pred} = 1/m*\hat{DC}$$

Year	\hat{DC}	\hat{MS}_{act}	\hat{MS}_{pred}	Residual 1	\hat{Y}_{actual}	\hat{Y}_{pred}	Residual 2
ESTONIA $v=5.2401$ $m=0.8814$							
1993	1765.9	2433.6	382.34	2,051.26	8902	2,003.52	6,898.48
1994	1860.1	1091.7	402.74	688.96	9043	2,110.39	6,932.61
1995	4100.3	1857.2	887.78	969.42	10410	4,652.03	5,757.97
LITHUANIA $v=2346.13$ $m=0.5017$							
1993	172.08	668.1	0.15	667.95	7721	342.99	7,378.01
1994	6217.5	248.3	5.28	243.02	5873	12,392.86	6,519.01
1995	1081.9	1031.5	0.92	1,030.58	6848	2,156.47	4,691.53
LATVIA $v=15068$ $m=0.4459$							
1993	0.05301	0.021249	0.000008	0.02124	462.4	0.119	(0.066)
1994	0.381061	0.08335	0.000057	0.08329	575.6	0.855	(0.474)
1995	-0.24495	0.00265	(0.000037)	0.00269	318.1	(0.549)	0.304

The results of the estimated predicted values of M_s and Y presented in the table above are very ambiguous. The residuals are very high. Such ambiguous results could be attributed

to the quality of the data that is reported to the IMF in dollars and could not, on account of exchange rate, be converted into local currency.

Table 9 PREDICTIONS (by method II)

Year	\hat{DC}	\hat{MS}_{act}	\hat{MS}_{pred}	Residual 1	\hat{Y}_{actual}	\hat{Y}_{pred}	Residual 2
ESTONIA $v=1.2197$ $m=0.56309$							
1993	1765.9	2433.6	2,571.20	(137.60)	8902	3,136.09	5,765.91
1994	1860.1	1091.7	2,708.35	(1,616.65)	9043	3,303.82	5,739.12
1995	4100.3	1857.2	5,970.14	4,122.94	10410	7,281.78	3,128.22
LITHUANIA $v=1.2197$ $m=0.56309$							
1993	172.08	668.1	250.55	417.55	7721	305.60	7,415.40
1994	6217.5	248.3	9,052.84	(8,804.54)	5873	11,041.75	(5,168.75)
1995	1081.9	1031.5	1,575.27	(543.77)	6848	1,921.36	4,926.64
LATVIA $v=1.74952$ $m=0.20507$							
1993	0.05301	0.021249	0.1478	(0.1266)	462.4	0.258	462.14
1994	0.381061	0.08335	1.0623	(0.9790)	575.6	1.858	573.74
1995	-0.24495	0.00265	0.6827	(0.6854)	318.1	(1.194)	(316.91)

The predicted values of Ms and Y obtained by using the regression coefficients v and m are less volatile but are as ambiguous as the results obtained above. Thus, the predictions are not reliable using either method of calculation and further studies will have to be done searching out more reliable set of data.

CONCLUSIONS

The present study was intended to estimate the coefficients v , income velocity of money, and m , marginal propensity to import, by using Polak model and test the hypothesis that developing countries utilising currency board arrangements are expected to have higher v and m than the countries using some other arrangements. To better understand the nature of the currency boards and its effect on the economy one section was devoted to the history, operational principals and arrangements of currency boards, and description of the implementation of the currency board in Estonia.

For a country interested in having its own currency but uncertain of its ability to undertake discretionary management of the currency, or make it acceptable in international trade and payments, a currency board may offer a shortcut to monetary stability and convertibility. The domestic currency serves as a proxy for the reserve currency, but the ICA intercepts seigniorage for the government and retains more flexibility for the future (say, in terms of the option to change the reserve anchor or to expand into full-fledged central bank). A fixed exchange rate peg is the simplest to operate and offers maximum credibility, but more complicated schedules may be useful in periods of transition.

With Estonia's introduction of its currency board in June, 1992, a major step was taken toward ensuring a market-based system of financial intermediation that served to stabilise and support its drive for serious economic reforms. It was part of the general commitment to sound financial policies that has been absolutely crucial in explaining the Estonian success in economic stabilisation and reform.

There is little doubt that the currency board arrangement introduced by Estonia has served it well in assisting its emergence from a difficult economic situation. Although some

economists view the currency board as anachronistic, the Estonian example proves its viability and justifies its use for emerging market economies to promote price stability, foreign trade, saving and investments.

To test the hypothesis that developing countries utilising the currency boards are expected to have higher v and m the Polak model was applied to the data sample of 8 developing countries over the period of 4 years.

The estimation results obtained by two different methods, method I (by ratios) and method II (by regression), are ambiguous. But overall there is a tendency for a higher coefficient of income velocity of money and marginal propensity to import for Estonia, and Lithuania than other countries in the sample. Ambiguity of the estimation results of the Polak model for developing countries are not unusual. The review of the earlier studies done by the International Monetary Fund shows that such results are common. One of the reasons is the unreliable compilation of the economic data for Estonia and other countries of the former Eastern block that make up the sample. Another possible explanation is that developing countries are very susceptible to many shocks, their economies are not stable and are experiencing high fluctuations in major economic variables.

Overall, the estimations obtained by the present study should be viewed as provisional and not intended to provide a definitive study of the application of the Polak model to any of the countries used in this sample. It is entirely probable that a more intensive study of the monetary structure and payments data over a prolonged period of time for Estonia, Lithuania and other countries used in this study would lead to refinements that would improve the empirical results.

APPENDIXES

DATA USED IN ESTIMATION

Y : GDP
IMP: imports
X : exports
CF: net cash flow

Ms: money supply
DC : domestic credit
VE= X+CF+DC

Data is in mil. of national currency units

Year	IMP	VE	Y	Ms	DC	Year	IMP	VE	Y	Ms	DC
ESTONIA						LITHUANIA					
1992	9192.05	12800.66	13158	2854.6	2876.5	1992	8541.234	9881.81	3387	1557.3	114.72
1993	16896.5	30509.68	22060	5288.2	4642.4	1993	9490.26	11766.45	11108	2225.4	286.8
1994	26078.5	34973.52	31103	6379.9	6502.5	1994	10461.06	17280.3	16981	2473.7	6504.3
1995	35066.8	49304.25	41513	8237.1	10602.8	1995	15620.4	21038	23829	3505.2	7586.2
LATVIA						UKRAINE					
1992	831.66	773.69305	1004.6	0.246533	0.483052	1992	10523.7	14584.97	50.3	20.7	83.7
1993	749.105	966.22106	1467	0.267782	0.536062	1993	952.36	21369.379	1446.9	341.9	907.4
1994	888.856	1120.4811	2042.6	0.351132	0.917123	1994	898.269	31150.431	11959.6	1860	5817.1
1995	1180.33	1533.8072	2360.7	0.353782	0.67217	1995	2660.93	61747.57	12437.9	4681.9	16915.5
CZECH REPUBLIC						HUNGARY					
1992	458738.6	628898.88	8207000	204.65	1339.68	1992	1239145.3	1342751.4	2935100	735.48	4101.61
1993	509709.5	698777.55	910600	268.97	1488.55	1993	1683804.7	2557525.7	3537800	811.73	4780.65
1994	536456.3	767057.68	1037500	403.97	1797.48	1994	1802365.3	2128465.8	4351000	895.58	5542.33
1995	799170.4	1220898.1	1252100	431.08	2219.13	1995	2990376.3	4667031.6	4986300	940.359	6083.67
SLOVAC REPUBLIC						POLAND					
1992	248918.3	784374.97	344007	108452	539764	1992	37609	116942.21	114944	14963	87808
1993	270563.1	852581.58	369900	116615	586700	1993	55063.3	179830	155780	19646	126660
1994	260600	847407.52	441300	123820	549150	1994	68568.2	239666.4	210377	27450	164820
1995	311154.6	931018.46	518000	149657	533138	1995	99589	356876	223004	37439	197902

Source: International Financial Statistics,
IMF

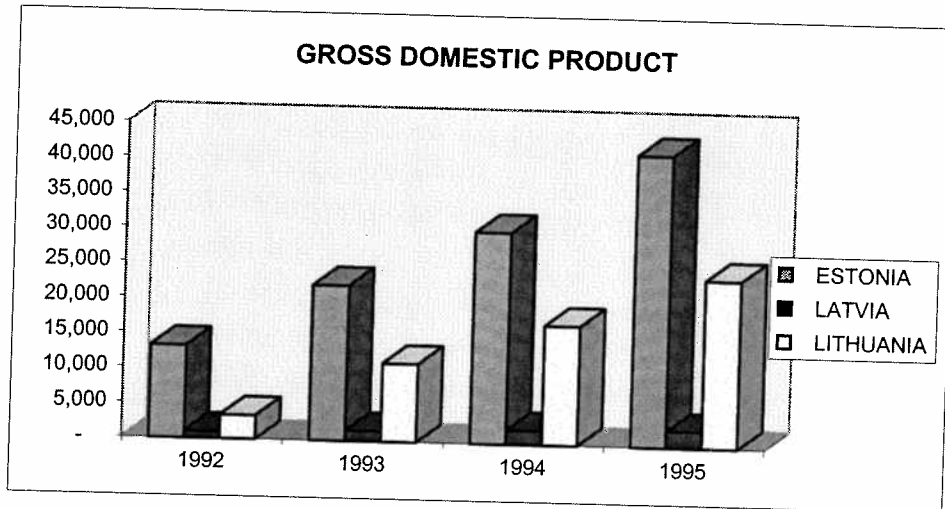
APPENDIXES

TABLE 1

**BALTIC COUNTRIES
SELECTED ECONOMIC INDICATORS
(mil. of nat.curr)**

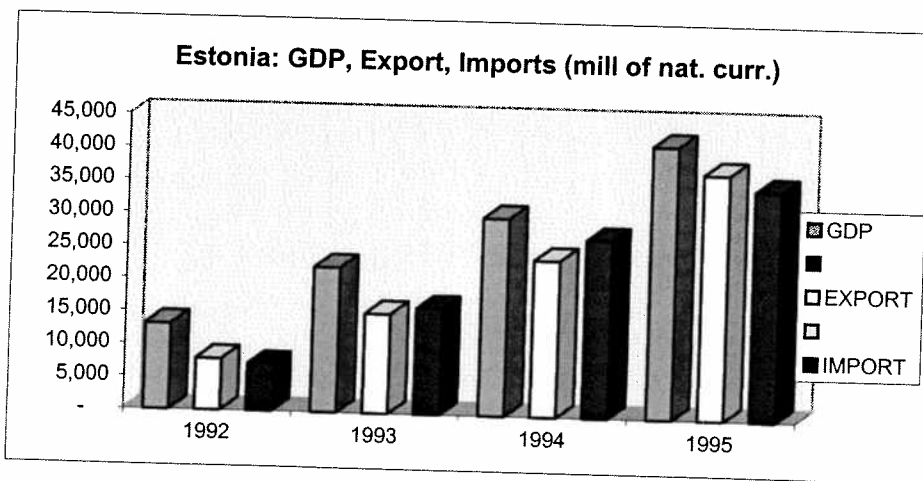
GROSS DOMESTIC PRODUCT

	1992	1993	1994	1995
ESTONIA	13,158	22,060	30,103	41,503
LATVIA	1,004.6	1,467.0	2,042.6	2,360.7
LITHUANIA	3,387.0	11,108.0	16,981.0	23,829.0



ESTONIA

	1992	1993	1994	1995
GDP	13,158	22,060	30,103	41,503
EXPORT	7,893	15,197	23,799	37,327
IMPORT	7,121	16,125	27,034	34,922



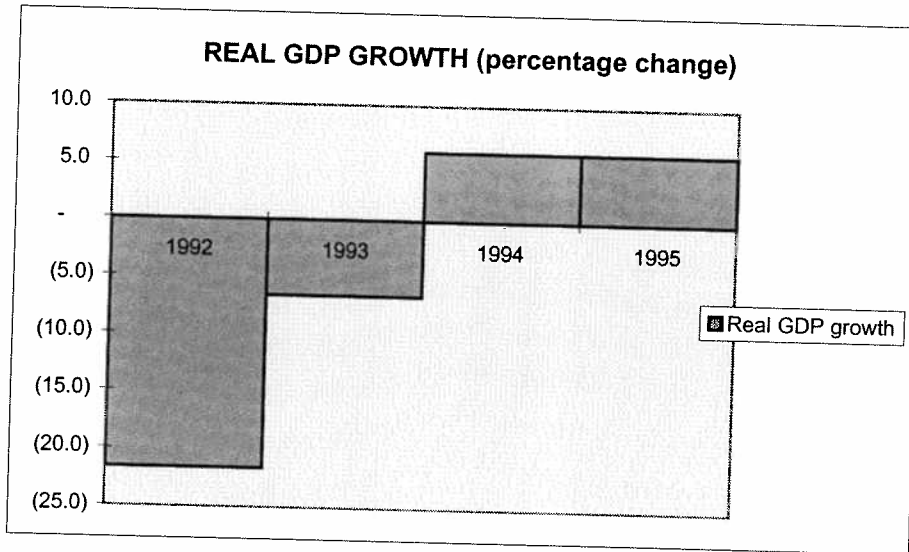
Data: IMF International Financial Statistics

APPENDICES

TABLE 2

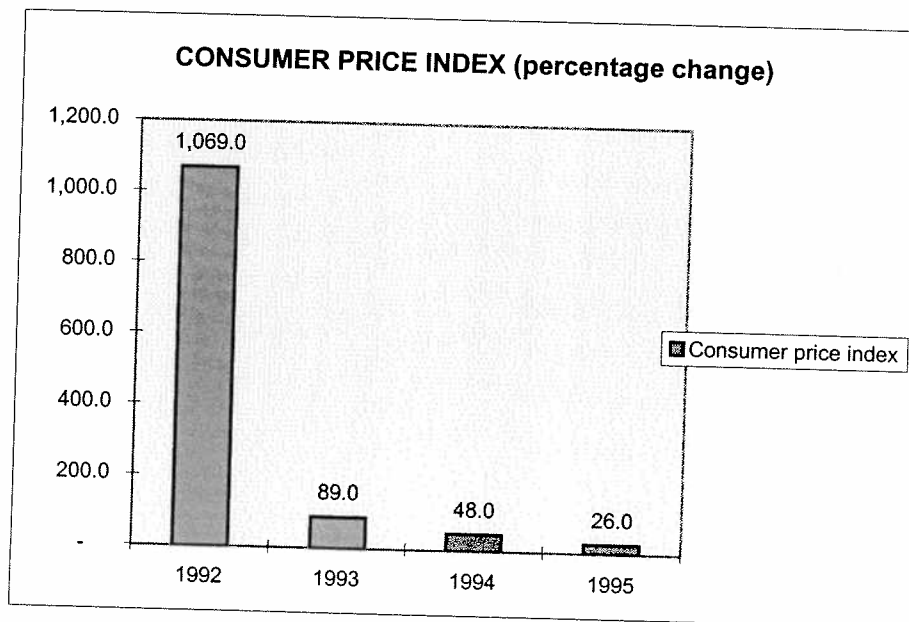
ESTONIA

	1992	1993	1994	1995
Real GDP growth	(21.6)	(6.6)	6.0	6.0



ESTONIA

	1992	1993	1994	1995
Consumer price index	1,069.0	89.0	48.0	26.0

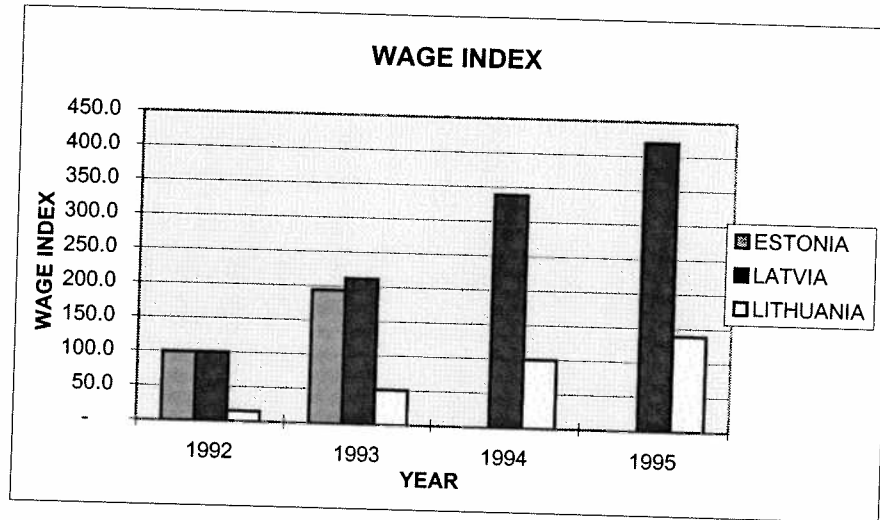


(Data: Estonian authorities and IMF estimates)

APPENDIXES

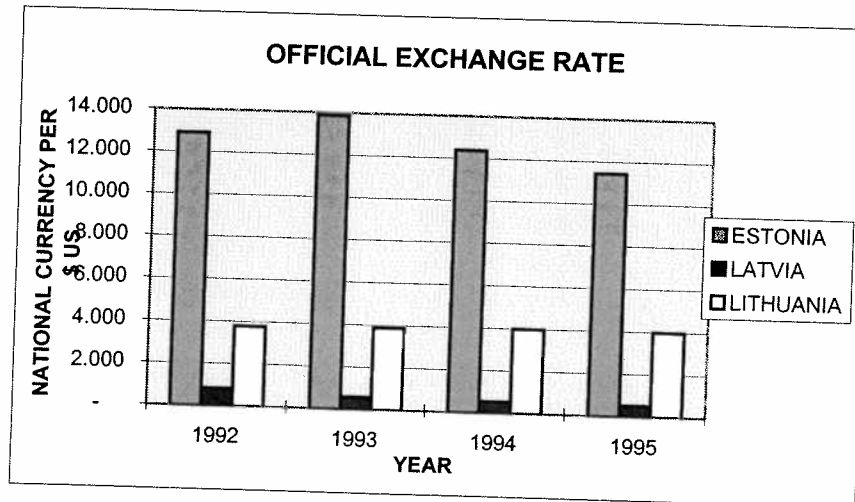
WAGES
(Index number)

	1992	1993	1994	1995
ESTONIA	100.0	194.2		
LATVIA	100.0	211.7	338.6	420.3
LITHUANIA	15.1	51.1	100.0	139.1



OFFICIAL EXCHANGE RATE
(national currency per \$US)

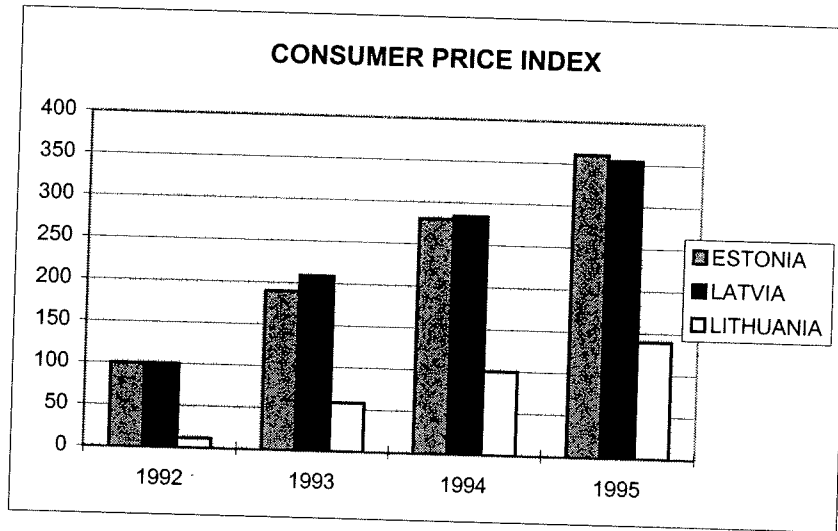
	1992	1993	1994	1995
ESTONIA	12.912	13.878	12.390	11.462
LATVIA	0.835	0.595	0.548	0.537
LITHUANIA	3.790	3.900	4.000	4.000



APPENDIXES

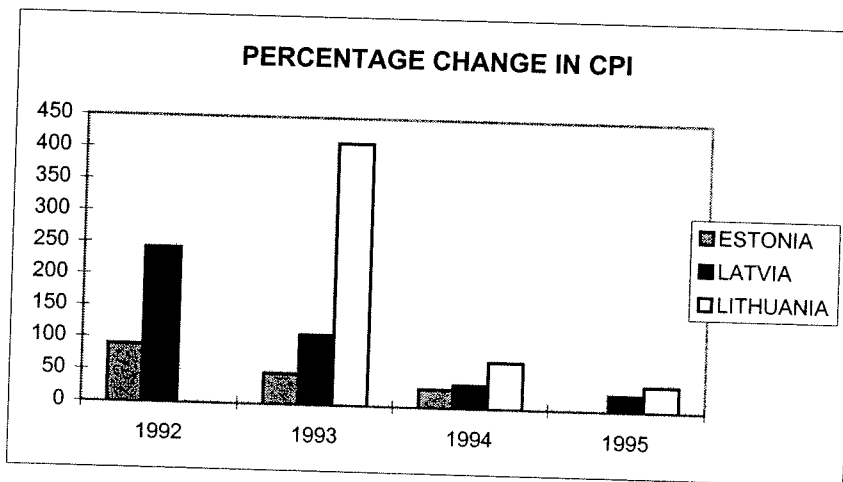
CONSUMER PRICE INDEX

	1992	1993	1994	1995
ESTONIA	100	189.8	280.3	360.9
LATVIA	100	208.8	283.8	354.7
LITHUANIA	11.4	58.1	100	139.7



PERCENTAGE CHANGE IN CPI

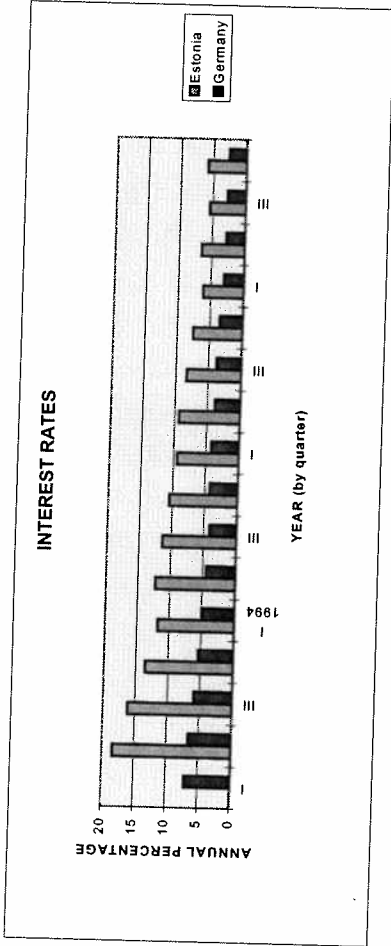
	1992	1993	1994	1995
ESTONIA	89.81	47.66	28.78	
LATVIA	243.27	108.77	35.93	24.98
LITHUANIA		410.24	72.19	39.66



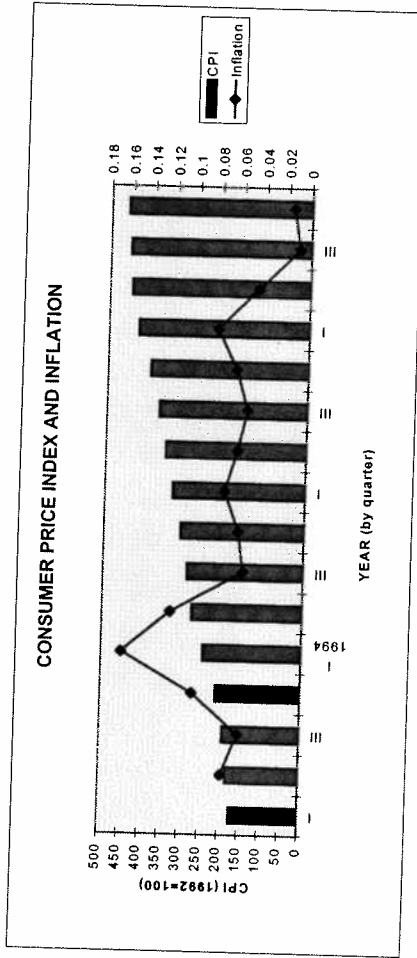
Data: IMF International Financial Statistics

INTERNATIONAL FINANCIAL STATISTICS

Interest rate	1993				1994				1996			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Estonia	7.15	6.85	5.92	5.37	4.97	4.49	4.15	4.27	4.25	3.91	3.77	3.48
Germany	18.4	13.6	11.8	12.3	11.4	10.5	9.5	8.4	7.6	6.2	6.6	5.9
										3.02	2.85	2.79
												2.66



CPI (1992=100)	1993				1994				1996			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
CPI	171	183	193.2	212.1	246.5	275.8	290.8	308	330.3	350.7	369.7	445
Inflation	0.07	0.06	0.10	0.16	0.12	0.05	0.06	0.07	0.06	0.05	0.06	0.05
												0.08
												0.01
												0.02



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