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Growth, Nontradables, and Price Convergence in the Baltics

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Abstract

This paper reviews the recent real exchange rate appreciation observed in the three Baltic countries. Until now, this phenomenon may be viewed primarily as a consequence of the undervalued real exchange rates of the new currencies. Looking ahead, a tendency for continued real appreciation is to be expected as part of the transition process toward higher income levels, due in part to differential productivity growth rates in the tradable and nontradable sectors. In the absence of an appreciation of the nominal exchange rate, this real appreciation will occur through inflation rates that are higher than in industrial countries. Provided that the current prudent economic policies are continued, such higher inflation will not threaten macroeconomic objectives and may indeed be viewed as an indication that the transition process is progressing as expected.

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Summary

Tight monetary and credit policies have been a cornerstone of the economic policies followed in all three Baltic countries since the adoption of their stabilization and reform programs in mid-1992. These policies have been supported by controlled fiscal outcomes and have yielded stability in the exchange rates of the newly introduced currencies. Inflation has also fallen sharply from the high rates experienced in 1992. However, price increases remain high by industrial country standards, averaging 2 to 3 percent a month in late 1994 and early 1995.

This paper discusses the factors behind this continued high inflation. It is argued that the initial undervaluation of the new currencies is a significant cause of the recent inflation. The initial undervaluation relative to fundamentals may have been due to a range of asset market considerations including risk, incomplete markets and legal arrangements, imperfect information, and the irreversibility of investment. Evidence for the undervaluation of the real exchange rate can be found in price surveys, which suggest that the general price level may be far lower than in industrial countries and lower than would be normal for countries with income levels similar to those of the Baltics.

As the initial real exchange rate undervaluation is eliminated, and growth picks up, inflation in the Baltics is likely to be driven mainly by structural factors related to differential growth rates in the tradable and nontradable sectors. The standard two-sector model of Balassa and others suggests that the tendency for productivity growth to be faster in the tradables sector will result in increases in the relative price of nontradables and an appreciation of the real exchange rate. These effects may be quite important in countries that experience high growth rates, and they would imply that the real appreciation in the Baltics may be a sustained phenomenon.

A simple scenario is presented to shed light on the possible evolution of prices and incomes in coming years. The likelihood of continuing real appreciation implies that it will not, in general, be possible to target both the exchange rate and the price level at the same time. In particular, given an undervalued real exchange rate and a fixed nominal exchange rate, a restrained credit policy in itself will not bring about low inflation outcomes, since balance of payments inflows will lead to monetary growth and price increases. Alternatively, if price stability is targeted, it may be necessary to allow for periodic nominal revaluations.

I. Introduction

Tight monetary and credit policies have been a cornerstone of the economic policies followed in all three Baltic countries since the adoption of their stabilization and reform programs in mid-1992. These policies have been supported by controlled fiscal outcomes, and have yielded stability in the exchange rates of the new currencies. Inflation has also fallen sharply from the high rates experienced in 1992. However, price increases remain high by industrial country standards, averaging 2 to 3 percent per month in late 1994 and early 1995.

This paper will discuss the factors behind this continued high inflation. It is argued that the recent inflation primarily reflects the initial undervaluation of the newly introduced currencies. In the future, given exchange rate regimes and assuming restrained financial policies, inflation is likely to persist, mainly reflecting structural factors, particularly the differential productivity growth rates in the tradable and nontradable goods sectors. The analysis focuses on the three Baltic countries, but similar conclusions would apply to other transition economies as well.

The paper is organized as follows. Section II provides some background on the current institutional environment and recent wage and price developments. Section III briefly reviews the relevant economic theory which suggests a link between the real exchange rate and sectoral productivity growth. Section IV is devoted to a discussion of available empirical evidence while the potential medium-term implications for the Baltics are discussed in Section V. Finally, Section VI provides some policy conclusions.

II. Institutional Background and Recent Developments 1/

The three Baltic countries have made significant progress toward financial stabilization since the adoption of their stabilization and reform programs in mid-1992. Estonia was the first to take major steps toward reform, introducing a currency board arrangement in June 1992, which provided for a fixed exchange rate of the newly introduced kroon to the deutsche mark and full foreign exchange cover of kroon bank notes and banks' reserve deposits. Fiscal policy was supportive of the new arrangement, with modest financial surpluses ensuring that the Government was not required to seek financing from the Bank of Estonia. The currency board arrangement gained credibility quickly, and foreign reserves grew rapidly due to capital inflows.

1/ Further details on economic developments and policies are provided in the relevant issues of the IMF Economic Surveys series and in Saavalainen (1995).

In Latvia, the authorities decided on a more conventional central bank arrangement, supported by a law that provided for a strong, independent central bank which would be able to implement firm monetary and credit policy. The newly introduced currency (the Latvian ruble from July 1992, and the lats from May 1993) was supported by tight credit and base money targets, which led to a significant nominal appreciation of the currency against the U.S. dollar. Fiscal policy was also appropriately firm with a near-balanced outcome in both 1992 and 1993. Following a period of sustained nominal appreciation, the Bank of Latvia has since February 1994 acted to ensure a fixed exchange rate against the SDR, with foreign exchange reserves standing at around five months of imports of goods and services at end-1994.

Lithuania was initially less consistent in its adoption of stabilization policies. The Bank of Lithuania allowed a relatively loose monetary policy until early 1993, with the result that the Lithuanian currency (the talonas from May 1992, and the litas from June 1993) depreciated against the dollar until May 1993. Fiscal policy outcomes were controlled, however, and following a tightening in monetary policy in the spring of 1993, the exchange rate began to appreciate and inflation fell significantly. In April 1994, the Bank of Lithuania instituted a currency board arrangement with the exchange rate fixed to the U.S. dollar.

The currency board arrangements in Estonia and Lithuania provide almost no room for a discretionary monetary policy. While inflation in these countries will still be influenced by monetary developments, these are the result of balance of payments outcomes and thus are outside the control of the central bank. A currency board arrangement sharply limits the scope for flexibility in fiscal policy as well, as there can be no recourse to central bank financing of the budget. In Latvia, there is scope for the operation of discretionary monetary policy, though this is also constrained by the policy of targeting exchange rate stability.

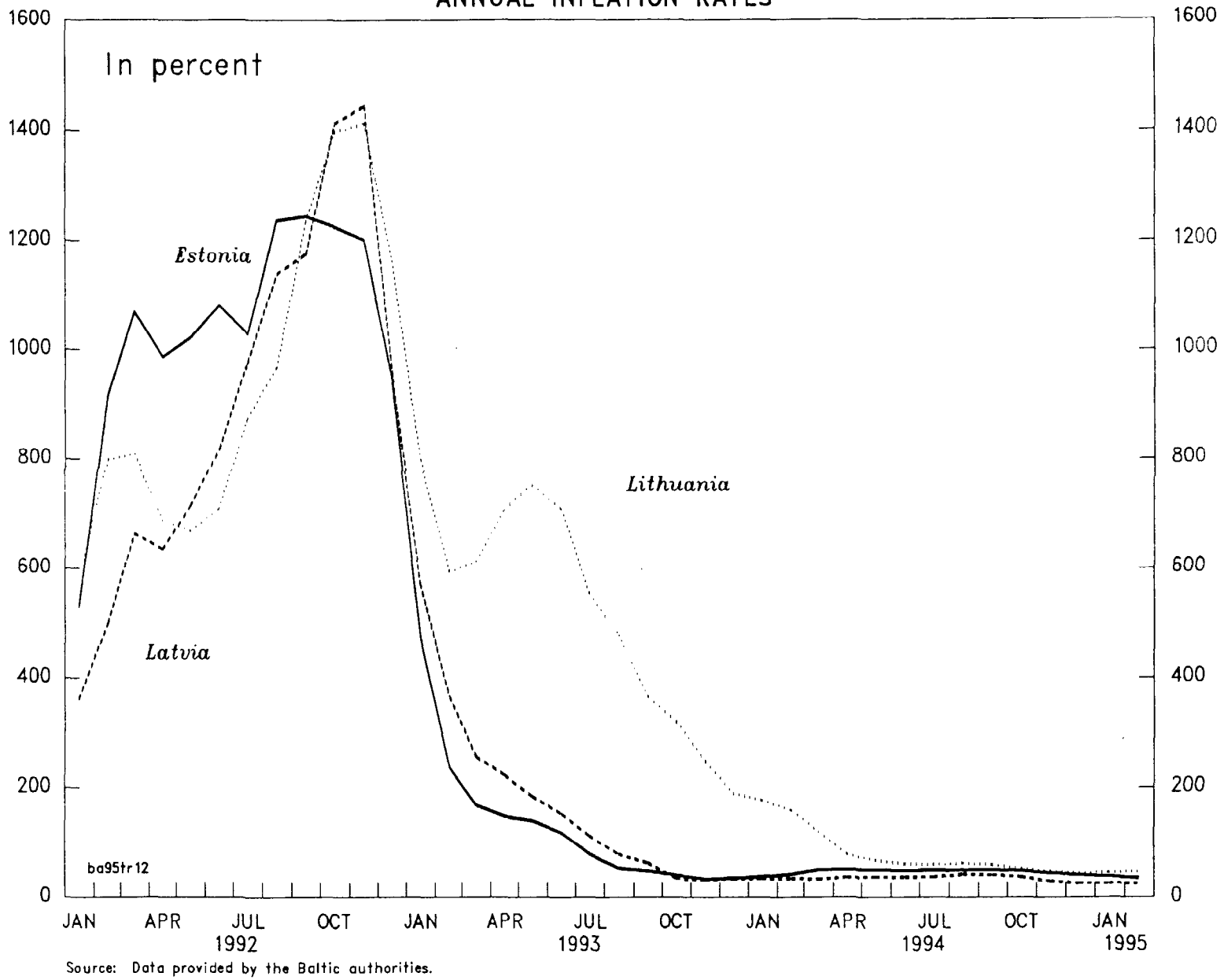
These institutional arrangements and policies have indeed contributed to the significant success in reducing the rate of inflation from the high rates that followed the liberalization of prices amid a huge monetary overhang in the beginning of the transition process (Chart 1). The rate of inflation has fallen steadily following annual rates of over 1,000 percent during 1992 in all three countries, reaching annual rates of 42 percent in Estonia, 26 percent in Latvia, and 46 percent in Lithuania, all in the 12 months to December 1994. While far lower than in most of the countries of the former Soviet Union (FSU), these inflation rates are still very high compared with the rates of around 3 percent in most industrial countries in late 1994.

As nominal exchange rates have recently been relatively stable, all three countries have experienced a considerable real appreciation relative to Western partner countries (Chart 2). In the two years to December 1994, the real effective exchange rate against the SDR (based on consumer prices) appreciated by 79 percent in Estonia, 141 percent in Latvia, and 203 percent

CHART 1

ESTONIA, LATVIA, AND LITHUANIA

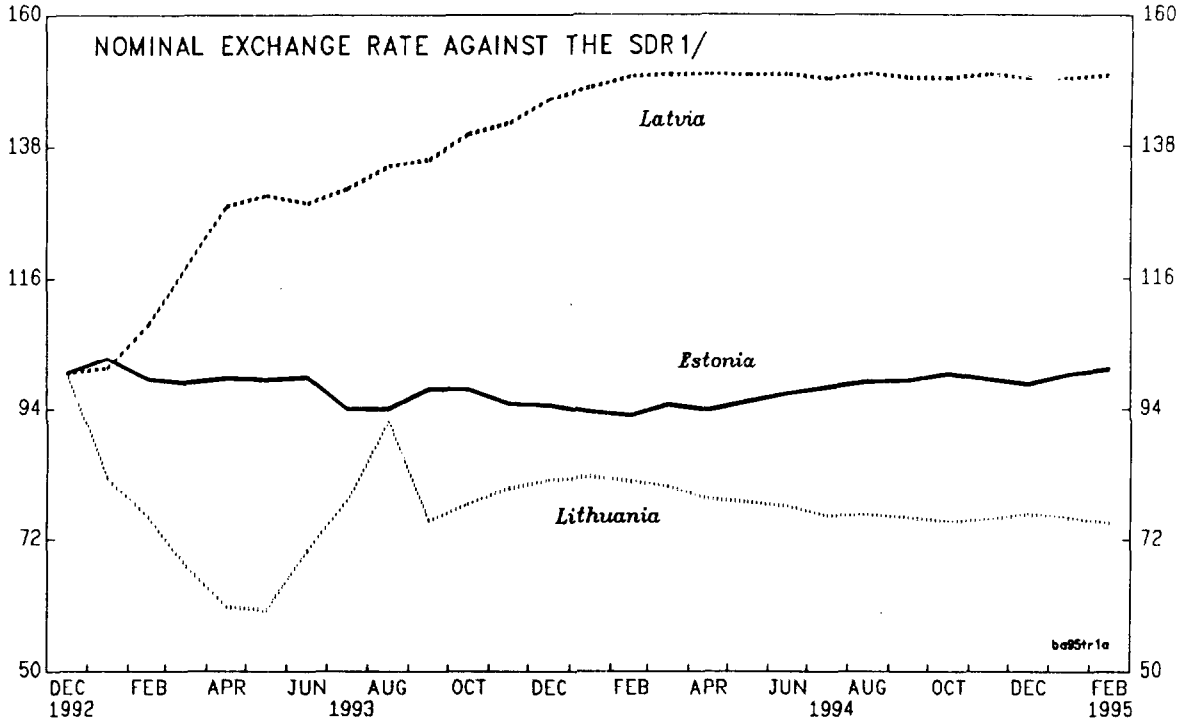
ANNUAL INFLATION RATES

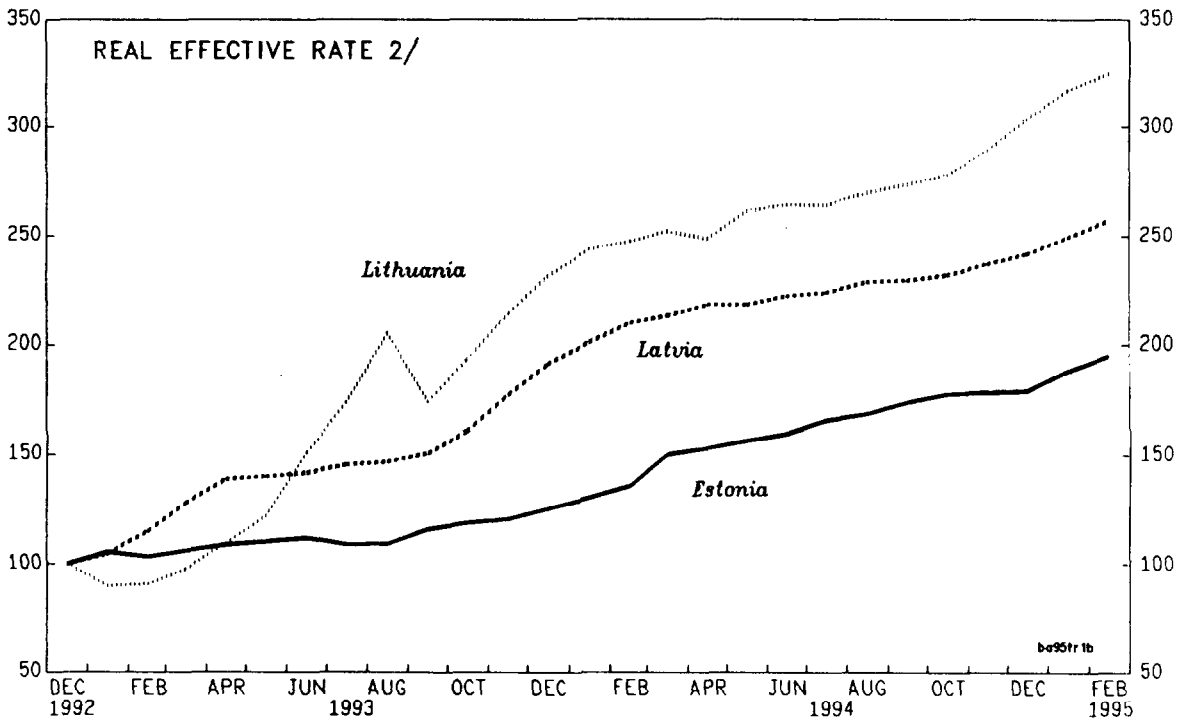


Source: Data provided by the Baltic authorities.

CHART 2

ESTONIA, LATVIA, AND LITHUANIA
EFFECTIVE EXCHANGE RATES
(December 1992 = 100)





Sources: IMF, International Financial Statistics; and estimates by theauthors.
1/ Increase implies an appreciation.
2/ Relative to the 5 industrial countries in the SDR basket.
Based on consumer price indices.

in Lithuania. However, to the extent that inflation has been highest in services, public utilities, transportation and other nontradables, this measure may overstate the effect on external competitiveness. As a result, the tradable goods sector may well still be highly competitive in international markets. Indeed, exports continue to grow strongly, particularly to countries outside the FSU and Baltics, which now account for more than half of total exports from all three countries.

As a result of significant growth in the level of U.S. dollar wages (Chart 3), wages are generally higher in the Baltics than in the FSU countries. However, wages remain somewhat lower than in the more advanced transition economies of Central and Eastern Europe (Table 1). 1/ The gap with respect to industrial countries is far larger, with wages in the Baltics at only about 6 percent of Northern European levels, where monthly wages average around US$2,000. Data on per capita GDP (converted at market exchange rates) convey a broadly similar picture, with per capita GDPs in the Baltics also at around 6 percent of Northern European levels. Estimates for 1994 indicate, however, that economic growth has resumed in the Baltics, with GDP growth of around 6 percent in Estonia and around 2 percent in both Latvia and Lithuania.

While it is clear that labor productivity is generally lower in the Baltic countries (and the other countries in transition) than in the industrial countries of Northern Europe, it is unlikely that the true productivity differences are as great as is implied by these wage and GDP data. This may be the consequence of substantially undervalued real exchange rates in the Baltics during the early stages of transition. The existence of an initial undervaluation relative to fundamentals may be due to a range of asset market considerations including risk, incomplete markets and legal arrangements, imperfect information and the irreversibility of investment. As these factors are unwound, it may be expected that the real exchange rate will appreciate.

A simple price comparison between Latvia and Sweden (described in Appendix I) lends support to the idea that the real exchange rates of the Baltic countries may be undervalued relative to fundamentals. In the case of food items, Latvian prices were estimated at around only 37 percent of Swedish prices in March 1994. 2/ The prices of many other goods and

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1/ Wage data for all the countries in transition are for the state sector only and exclude payroll taxes. To the extent that wages in the private sector are higher, the true level of average wages is likely to be higher than is indicated here. Since the statistical coverage of the emerging private sector in the Baltics is still incomplete, the true income level in the Baltics is also likely to be underestimated in the national accounts.

2/ Furthermore, based on the movements in the food components of the Latvian and Swedish CPIs one can infer that Latvian prices were only around 7 percent of Swedish levels in July 1992. The increase in this period corresponds to the real appreciation of the Latvian currency.

almost all services appear also to have been below Swedish levels, suggesting that the general price level in Latvia may have been far below the Swedish level. Similar comparisons would likely exist for the other Baltic countries, and De Masi and Koen (1995) have shown similar results in a comparison between Russian and French price levels.

While differences in price levels across countries are well documented, and appear to be strongly related to income levels, the differences noted above appear far larger than would be expected based on international data. A tendency for these differences to be removed is to be expected, and given the fixed exchange rate regimes currently existing in the Baltics, the increase in the price level (or equivalently the real exchange rate) is occurring through higher inflation rather than a nominal appreciation. It seems likely that the adjustment toward world prices--or the appreciation of the real exchange rate--is not yet complete, and that this will continue over the next few years. However, as this initial undervaluation is removed, the nature of the inflation will change, as is discussed in the following section.

III. The Economics of Real Exchange Rate Adjustments

As the initial real exchange rate undervaluation is removed, and growth picks up, inflation in the Baltics is likely to be driven mainly by structural factors related to differential growth rates in the tradable and nontradable sectors. These factors are well documented in the literature, with seminal contributions including the work of Cassel (1918), Harrod (1933) and Samuelson (1964). Furthermore, the two-sector tradable and nontradable goods model used in this section is standard in the "open economy macroeconomics" literature including an important article by Balassa (1964).

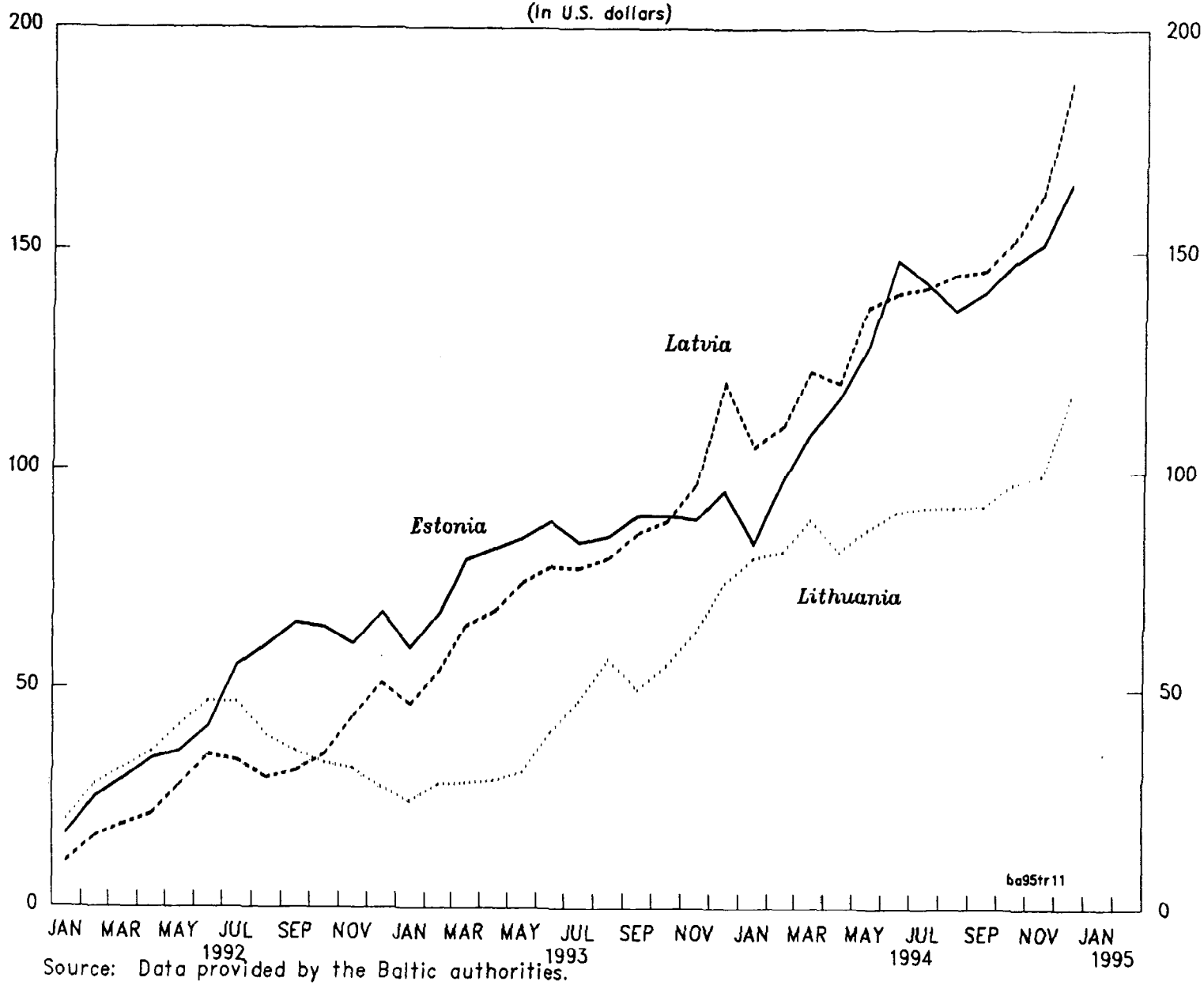
The model starts with the basic assumption that prices of tradable goods are determined in world markets and therefore equalized across countries when converted into a common currency using market exchange rates. Prices of nontradable goods are assumed to be determined domestically based on the domestic wage and productivity levels. To the extent that productivity in the two sectors within a country grows at different rates, it is likely that there will be offsetting movements in the relative price of nontradables. If, for example, the trend growth of productivity in the tradable goods sector exceeds that of the nontradable goods sector, there will be a tendency for the relative price of nontradables to go up over time.

CHART 3

ESTONIA, LATVIA, AND LITHUANIA

AVERAGE MONTHLY WAGES

(In U.S. dollars)



Source: Data provided by the Baltic authorities.

These points are illustrated in the following simple model. Assume that there is an economy-wide wage which is equal to the marginal product of labor in each sector:

$$P^t(Y^t/L^t)=W=P^n(Y^n/L^n)$$

where Y represents output, L employment, P the relevant price index, W the wage level, and where superscripts t and n represent tradable and nontradable goods, respectively. Domestic demand is distributed between tradable and nontradable goods according to a Cobb-Douglas function with a unit elasticity of substitution between the two goods:

$$Y^d=(Y^t)^\rho(Y^n)^{(1-\rho)}$$

Because of the assumption of a unitary elasticity of substitution, the share of nontradables in total spending is constant in nominal terms. Under Cobb-Douglas preferences, the price index of domestic demand is:

$$P^d=(P^t)^\rho(P^n)^{(1-\rho)}$$

Under these assumptions, the relative price of nontradables grows at a rate equal to the difference between the rates of growth of productivity in the two sectors. With small letters denoting rates of change, the overall inflation rate depends on inflation in the tradable goods sector, the difference in productivity growth in the tradable and nontradable goods sectors, and the share of the nontradable goods sector in domestic demand:

$$p^d=p^t+(1-\rho)((y^t-l^t)-(y^n-l^n))$$

Assume, for instance, that each sector's share in demand and output equals 50 percent, and that productivity in the tradable goods sector grows by 8 percent per year while productivity in the nontradable goods sector grows by 4 percent, implying an overall productivity growth rate of 6 percent. In this case, the relative price of nontradable goods would increase by 4 percent per year, while the effect of the higher nontradables inflation on the overall price index would amount to 2 percent.

The theory also has important international implications. To the extent that there are differences in productivity across countries, wages will differ as well. In developing countries, productivity is generally lower than in industrial countries. While this applies to both sectors of the economy, there is evidence that the productivity gap is larger for tradables than it is for nontradables. Because of this, nontradables prices will typically be lower in developing countries than in industrial countries. Since the overall price level is a weighted average of the price levels of tradable and nontradable goods, the general price level will be

lower in developing countries, with the difference being a function of the proportion of goods that are nontradable, and the price differential for nontradables.

The earlier literature has recently been extended to consider the link between productivity and real exchange rates in the context of an explicit general equilibrium framework as, for example in Backus and Smith (1993), Tesar (1993), and Asea and Mendoza (1994). Using a related methodology, a note attached to this paper illustrates the dynamics of the process for consumption, and investment, and for the tradable and non-tradable sectors (Appendix II). The model confirms that the relative price of nontradables increases significantly in response to positive productivity shocks in the tradable goods sector. This would imply that strong productivity growth in the tradable goods sector in the Baltics could result in an increase in nontradables prices and an appreciation of the real exchange rate.

IV. Empirical Evidence

The empirical evidence on the linkages between income, sectoral productivity growth, and prices can be divided into two groups. First, there is a considerable literature documenting that productivity improvements typically lead to an appreciating real exchange rate. In addition, the hypothesis that inflation in the nontradables sector generally exceeds that of tradables is supported by a number of recent industrial country studies including De Gregorio, Giovannini, and Wolf (1994) and Micossi and Milesi-Ferretti (1994). The latter study also establishes the connection to differential productivity growth.

Second, there is an extensive literature showing a cross-country relationship between income and price levels. Detailed price level surveys have been undertaken through the International Comparison Project (ICP) for several decades for a wide range of countries. As reported by Kravis, Heston and Summers (1982) and Summers and Heston (1991), the ICP data overwhelmingly reject the hypothesis that price levels are equal across countries and thus reject the broadest form of the purchasing power parity (PPP) hypothesis. Another interesting result concerns the failure of PPP to hold for more narrowly defined tradable product groups. This partly reflects the fact that categorizing goods into tradables or nontradables is far from straightforward. In almost all cases, the domestic price of tradable goods has a nontradable component. To the extent that the labor cost involved in distribution and sales is lower in a developing country, final prices may not be equalized across countries even for fully tradable goods. According to Kravis and Lipsey (1982), while price differences for tradables are smaller than for nontradables, they are nonetheless large enough to suggest that there is a substantial nontradable element to goods that are typically considered to fall in the tradable goods category.

Studies by Kravis and Lipsey (1987) and Clague (1988) also support the hypothesis that national price levels are strongly and positively correlated with PPP-adjusted per capita GDP. Other factors that have been found to be correlated with the price level include the level of education, the proportion of GDP that is produced in agriculture or from natural resources, and the degree of openness of the economy. One explanation for this last effect in the context of this paper is that the openness ratio can be thought of as the product of the proportion of GDP that is tradable and the proportion of tradables that are actually traded.

Cross-country data may be useful in inferring the possible equilibrium price level--or real exchange rate--of countries with income levels similar to those of the Baltics. The regression equation below is based on 1990 data from the 73 countries participating in an ICP benchmark study and uses weighted least squares (with weights equal to PPP-adjusted GDPs so that larger countries receive larger weights). As expected, a simple linear regression reveals a positive and significant relationship between the price level relative to the United States and the level of income (see also Chart 4). 1/ In addition, it suggests that European countries typically have higher price levels than would be suggested by their income levels, while the U.S. price level is far lower than is implied by the income level in the United States.

Price Level Regression 1/

Variable	Coefficient	T-ratio 2/
Intercept	21.7	5.2
Relative income level	1.2	9.1
Dummy variable for Europe	12.1	1.5
Dummy variable for United States	-43.0	3.7

1/ Data from Penn World Tables (version 5.5). The equation explains some 88 percent of the variation in the price levels.
2/ Based on heteroskedasticity-consistent standard errors.

If PPP-adjusted GDP were 20 percent of the U.S. level, the regression suggests a price level of around 46 percent of the U.S. level, or around 58 percent for a European country. However, the available evidence suggests that the current price level is significantly below this estimate, perhaps

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1/ Relatively similar results are obtained for alternative specifications including in logarithms, or with squared income terms to allow a non-linear relationship.

closer to 40 percent of the U.S. level (see Appendix I for a detailed discussion). If that were the case, the real exchange rate would still be significantly undervalued from the point of view of current income levels. This could imply the scope for further real appreciation in the Baltics in the short run, which would occur either through nominal exchange rate appreciation or through higher inflation rates than in industrial countries.

V. Potential Medium-Term Implications

Given current price and income levels relative to those of Western Europe, the previous model and data would suggest that there is still scope for a significant real appreciation in the Baltic countries. However, although economic theory is helpful in illustrating the mechanisms which drive this process, it may be of less help in projecting how rapidly prices and incomes will converge toward industrial country levels. The poor quality of output data in the Baltic countries and the high degree of uncertainty surrounding political and economic developments in transition exacerbate the usual difficulties in this regard.

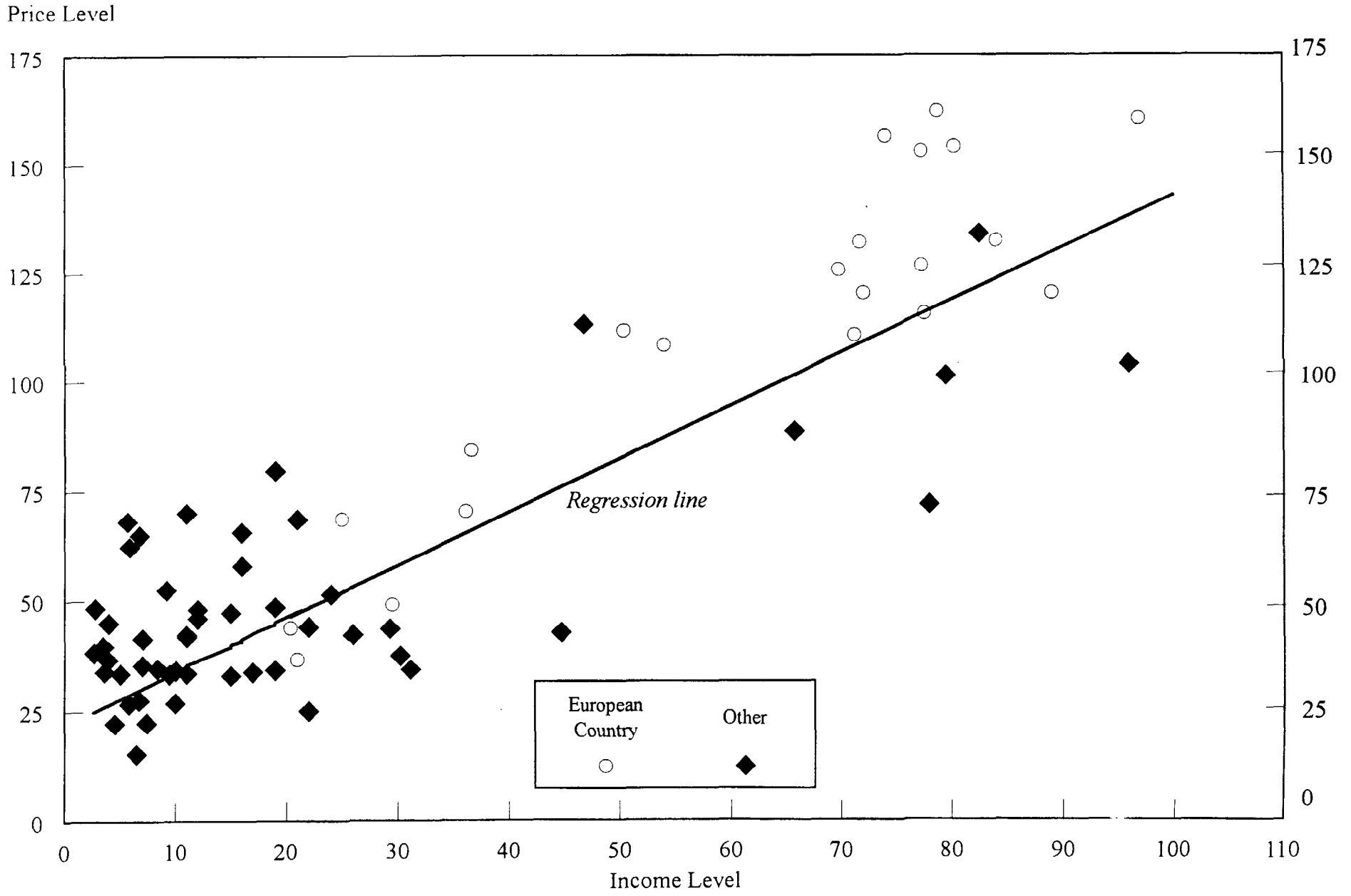
Despite the uncertainties involved, it may be useful to consider a simple example to shed light on the possible evolution of prices and incomes in coming years. A formal model exercise, which would require a full model calibration, is beyond the scope of this paper. Given initial starting conditions and projected income levels, the main objective is to remain broadly consistent both with the conclusions from the model exercise attached to this paper (Appendix II) and the empirical evidence on the correlation between income and price levels observed in other parts of the world.

Converted at a PPP conversion rate, GDP is at the outset assumed to amount to around 20 percent of the U.S. or numeraire level (Table 2). Assuming a price level around 40 percent of the numeraire level (see Appendix I), this implies a nominal per capita GDP (at market exchange rates) of around 8 percent of the numeraire level, roughly consistent with estimates for 1994 or 1995. For illustrative purposes, PPP-adjusted per capita GDP is assumed to grow at a constant rate to reach 40 percent of the numeraire level after 20 years, or around half the average Northern European level. The implied growth rate is around 4 percent per year above the

CHART 4

RELATIVE INCOME AND PRICE LEVELS

(United States = 100)



Source: Penn World Tables (version 5.5) and estimates by the authors.

growth rate of other countries. 1/ If per capita GDP in these countries were to grow by 2 1/2 percent per year, the implied growth rate for the Baltics would be around 6 percent.

It may be reasonable to focus on three different types of goods and services. The first group consists of "tradables" which are assumed to have a weight of 40 percent of the overall price index. The price level is assumed to amount initially to about 70 percent of the U.S. level (the numeraire price level) or around 60 percent of the Northern European price level. 2/ The second group of "nontradables" is assumed to have a weight of 50 percent and have a price level of 20 percent of the numeraire level. The third group consists of various "administered" goods and services which have a weight of 10 percent while the price level only amounts to 5 percent of the numeraire price level. Using fixed arithmetic weights, the implied average price level is around 40 percent of the U.S. level which is consistent with the data discussed in Appendix II, but somewhat below the level suggested by cross-country data. 3/

Assume that the price of tradables increases at a constant rate to reach 100 percent of the U.S. level after 20 years, and that the price of nontradables increases at a constant rate to reach 70 percent of the U.S. level after 20 years. The implied end-period difference between the price levels for tradables and nontradables would be consistent with the cross country data of Kravis, Heston, and Summers (1982). The price level of the administered category is assumed to grow at a constant rate (of around 50 percent per year) for five years so as to reach the "nontradable" price

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1/ The empirical literature on economic growth suggests that there is no automatic tendency for convergence in income levels. For example, Wolff and Gittleman (1993) find that two factors--investment and education--are most highly correlated with cross-country economic growth rates. Given that basic education levels in the Baltic countries are close to Northern European levels, it would seem logical to assume that income growth could be rapid if sufficient investment were forthcoming. To the extent that domestic savings are insufficient to finance this growth, there will be foreign investment to take advantage of the low-wage (but relatively highly skilled) labor force.

2/ It may seem odd that a class of tradables at 100 percent of the world price level is not assumed. However, with income levels (at market exchange rates) that are such small fractions of industrial country levels, it is clear either that the consumption of such goods must be extremely small, or that PPP income levels are far lower than assumed in the scenario.

3/ The assumption of a fixed share of the CPI for each class of goods is clearly an oversimplification. For example, it would seem that the weight of administered prices in the CPI is currently less than 10 percent, though the weight of these goods will be much higher than 10 percent when some administered prices (especially rents) have been adjusted to fully reflect all capital costs. The assumed weights can be thought of as average weights over the entire period.

level (30 percent of the numeraire level at that time), and then to grow in line with the nontradable price level.

If a fixed exchange rate and world inflation of 3 percent per year are assumed, the implied average annual inflation rate in the first five years is around 9 percent, with a slightly lower rate in the subsequent period when there is no boost from the administered component. Under these assumptions, the average price level rises from 39 percent of the numeraire level at the outset to 51 percent after five years and 82 percent after 20 years. This implies a level of per capita GDP at market exchange rates equivalent to about 40 percent of the U.S. level, which may be compared with the current levels of Turkey (20 percent), Malaysia (26 percent), Mexico (29 percent), Portugal (36 percent), Greece (36 percent), Cyprus (44 percent), and Israel (47 percent).

The implicit elasticity of the relative price level with respect to the income level is close to unity in this exercise which is significantly higher than either the model exercise of Appendix II or the regression analysis of Section IV. This primarily reflects the unwinding of the initial exchange rate undervaluation. Indeed, given the income levels assumed above, it is apparent that the average price level at the outset is somewhat below the level typically observed in other countries with similar income levels. The low initial price may also reflect an incomplete adjustment of administered prices and incomplete integration into Western Europe. These factors are assumed to be gradually unwound and to have been eliminated after 20 years when the price level reaches its predicted level of around 82 percent of the United States level. To the extent that these factors are unwound more quickly, the rate of inflation would be higher in the earlier years and lower in the later years. This would be consistent with the current situation where inflation in early 1995 remained well above the average rate in the illustrative scenario above.

VI. Concluding Remarks

After a country in transition has achieved a basic level of macroeconomic stabilization, in terms of a low inflation rate, restraint in the growth of domestic credit, a near-balanced fiscal position, and a sustainable balance of payments, the authorities can begin to focus on the desired growth path toward higher output levels.

During the early stages of transition, the price level in these economies may be below its equilibrium level (and also substantially below the price level of industrial countries). Initially, this may reflect an undervalued real exchange rate relative to economic fundamentals. The existence of such an initial undervaluation may be due to a range of asset market considerations including risk, incomplete markets and legal structures, imperfect information and the irreversibility of investment. All these factors may be especially important in the early stages of transition when there is incomplete adjustment to a market economy.

In the short term, real exchange rates will tend to rise both because of the undervaluation of the exchange rate when a fixed exchange rate was established or when the freely floating currency was introduced, and because of further liberalization of administered prices. In the longer term, real exchange rate adjustments will primarily be driven by structural factors, including differential productivity growth in the tradable and nontradable goods sectors. The low starting level of output relative to the relatively highly trained workforce suggests that there is the potential for very sizable productivity improvements over the coming years, and a sizable real appreciation.

The important point in this regard is that it will not, in general, be possible to target both the exchange rate and the price level at the same time. In particular, given an undervalued real exchange rate and a fixed nominal exchange rate, a restrained credit policy in itself will not bring about low inflation outcomes, since balance of payments inflows will lead to monetary growth and price increases. Alternatively, if price stability is targeted, it may be necessary to allow for periodic nominal revaluations.

Table 1. Average Monthly Wages and Per Capita GDP

(In U.S. dollars)

	1992	1993	1994
Average monthly wages 1/			
Estonia	46	83	131
Latvia	30	78	140
Lithuania	35	44	92
Russia	27	63	98
Ukraine	26	15	28
Belarus	44	22	24
Bulgaria	85	109	86
Czech Republic	170	205	235
Hungary	356	301	298
Poland	178	179	183
Romania	69	78	84
Per capita GDP (converted at market exchange rates) 2/			
Estonia	710	1,080	1,770
Latvia	520	870	1,360
Lithuania	490	750	1,460
Average for Baltics	570	900	1,530
Denmark	27,300	25,900	28,400
Finland	21,100	16,600	19,000
Germany	27,900	26,500	27,700
Norway	26,400	24,000	25,300
Sweden	28,500	21,300	22,100
Average for Northern Europe	26,200	22,900	24,500
United States	23,600	24,600	25,900

Sources: National authorities and estimates by the authors.

1/ Wages data are for the state sector only.
2/ Data for the Baltics may be underestimated due to coverage problems in the estimation of GDP.

Table 2. Estonia, Latvia, and Lithuania: Long-Term Price and Income Outlook

	First year	After 5 years	After 20 years
(Fraction of U.S. level)			
Per capita GDP (PPP terms)	0.20	0.24	0.40
Price level	0.39	0.51	0.82
Tradeables	0.70	0.78	1.00
Nontradeables	0.20	0.33	0.70
Administered	0.05	0.33	0.70
Nominal GDP (market exchange rates)	0.08	0.12	0.33
Price level predicted by cross-country regression	0.58	0.63	0.82
(Average annual percentage changes)			
Real GDP (assumes industrial country per capita GDP growth of 2 1/2 percent)	...	6	6
Prices (assumes fixed exchange rate, and industrial country inflation of 3 percent per annum)	...	9	7
Tradeables	...	5	5
Nontradeables	...	14	10
Administered	...	50	18

Source: Calculations by the authors.

A Simple Price Level Comparison between Latvia and Sweden

Since estimates of PPPs are not yet available for the Baltic countries, a simple comparison of prices in Latvia and Sweden was conducted to gain an idea of the difference in national price levels between the Baltic countries and the industrial countries of Northern Europe. This comparison involved the prices used in the compilation of the Latvian consumer price index (CPI) for March 1994, and estimates of consumer prices in Sweden based mainly on a survey of food prices in Stockholm in May 1994. Prices for both countries included the value added tax (VAT) where relevant, though there are not major differences in rates in the two countries. To the extent that goods or services may be of a higher quality in Sweden than in Latvia, the price differential will be biased upward, though an attempt was made to minimize such biases by obtaining the lowest possible prices in Sweden.

For food products, there was range of price differentials but in almost all cases, the Latvian price was lower than the Swedish price for the corresponding product (Table 3). Using CPI weights, the cost of the Latvian food basket was estimated at 37 percent of the Swedish level. 1/ For clothing and footwear, and basic household goods, prices in Latvia were around one-quarter of the Swedish level. For rents, however, the Latvian price was estimated at around only 2 percent of the Swedish level, in part reflecting quality differentials, but also because rents set by local governments do not fully reflect current interest and depreciation costs. Other administered prices also showed large differences. For many other services including housing-related services, restaurant meals, personal services, transportation services, and goods with a high local content, the average Latvian price may have been only 10 or 20 percent of the Swedish level. However, for some items such as electrical goods, there were only modest differences between Latvian and Swedish prices, probably because these goods came from the same suppliers.

An overall conclusion on the average price level difference will be heavily dependent upon the weights used. If Swedish weights are used, rents and many services would have a high weight, and would result in an estimate of a very large difference. If Latvian weights are used, where food accounts for around half the CPI, the estimate of the price differential will be smaller. To be conservative, based on Latvian weights, one might

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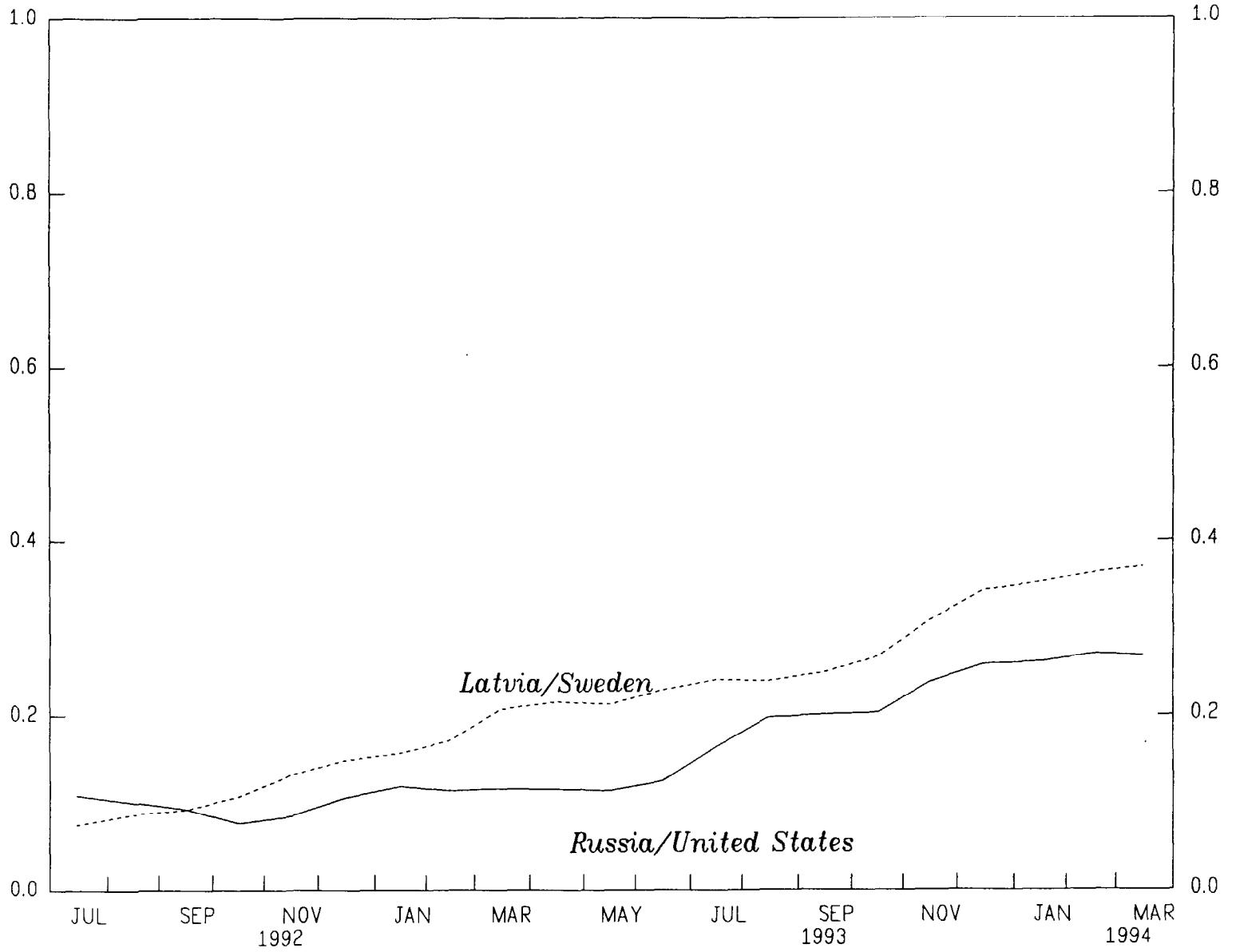
1/ A similar comparison in Koen and Meyermans (1994) suggests that food prices in Russia in late 1993 were around one-fourth of U.S. levels. When the March 1994 estimate of the price ratio for Latvia and Sweden is extrapolated backwards using data for the food component of each country's CPI (see Chart 5), the time path of the ratio appears similar to the ratio for Russia and the United States in Koen and Meyermans. See also De Masi and Koen (1995) for further evidence comparing Russian and French prices.

CHART 5

RATIO OF FSU FOOD PRICES TO "WORLD PRICES"



Sources: Staff estimates; see text for details.

conclude that the general level of consumer prices in Latvia in early 1994 was around 35 percent of the Swedish level, or around 40 percent of the U.S. level. 1/

Of course, part of this estimated differential may be due to quality differences. In some cases--e.g. Snickers bars, and McDonald's hamburgers--it appears that there are price differences for goods that should be quite homogenous across these countries. 2/ However, for many other products, the quality of the product typically purchased in Sweden will be higher than that typically purchased in Latvia. If quality differences existed and have not been fully accounted for in the above comparison, the true (i.e. quality-adjusted) price differential might be somewhat smaller than suggested above. The scope for a large bias, seems however to be limited by the implied real income difference. In particular, if Latvian prices were at 35 percent of the Swedish level or around 40 percent of the U.S. level, and Latvian per capita nominal GDP is at 6 or 7 percent of the U.S. level, Latvian real (i.e. PPP-adjusted) per capita GDP would be around only 15-20 percent of the U.S. level. A higher price level would imply an even lower PPP-adjusted GDP level, though it seems unlikely that Latvian real GDP was significantly lower than this figuring.

If there was, however, a significant quality differential, it is worth considering how this will affect the measured inflation rate in the future. The prices included in the CPI should represent estimates of the price of an item of a constant quality that is representative of the item that is typically consumed by the population. If an item is no longer available or no longer considered representative, the price of a replacement item will be introduced into the basket, using a splicing method to ensure that there is no sudden jump in the series. The need for splicing may be obvious in the case of large quality changes to an item, but it will be difficult when there are frequent but small changes in the quality of an item, including quality improvements such as the modernization of the buildings where goods are sold, or improvements in service from those who work in shops. Such quality improvements will most likely be reflected in higher prices in the CPI. Official statistics may therefore be expected to persistently overstate true price inflation and understate productivity and output growth. This is a further reason why it may be unreasonable to expect measured inflation rates to fall quickly to industrial country levels. 3/

1/ The Penn World Tables suggest that the Swedish price level was around 54 percent higher than the U.S. price level in 1990. Based on the depreciation of the Swedish krona since then, and relative inflation rates, this divergence may have narrowed to around 22 percent by March 1994.

2/ As of April 1995, the price of a Big Mac hamburger in Riga was around 54 percent of the price in Stockholm.

3/ A further factor is that the CPI cannot account for the introduction of new goods which may have major effects on the "cost of living". That is, they may significantly reduce the cost of purchasing a basket of goods which yields a constant level of utility (see Hausman, 1994).

Table 3. Comparison of Food Prices in Latvia and Sweden

Item	Weight in Latvian CPI (December 1993)	Price Ratio (Latvian price divided by Swedish price) 1/
Apples	0.48	0.15
Bread	9.22	0.16
Salt	0.48	0.17
Beef	1.64	0.18
Cucumber	0.85	0.19
Rolled oats	0.18	0.25
Potatoes	1.19	0.25
Vegetable soup	0.11	0.26
Mineral water	0.06	0.26
Cheese	1.22	0.31
Mayonnaise	0.04	0.35
Eggs	1.65	0.35
Sunflower oil	0.63	0.35
Instant coffee	0.24	0.36
Pork	2.35	0.37
Margarine	0.58	0.39
Onions	0.27	0.40
Flour	0.68	0.43
Sugar	2.91	0.44
Tomato sauce	0.04	0.48
Rice	0.15	0.50
Milk	2.13	0.51
Tea	0.09	0.55
Butter	2.01	0.55
Carrots	0.14	0.59
Snickers bar	0.11	0.61
Cabbage	0.31	0.61
Raisins	0.03	0.62
Oranges	0.55	0.64
Sausage	2.68	0.70
Honey	0.15	0.73
Bananas	0.47	0.82
Ice Cream	0.38	1.51
Total	34.02	...
Weighted median	...	0.35
Weighted average	...	0.37
Memorandum item:		
Total weight of food in CPI 2/	49.67	...

Source: Latvian State Committee for Statistics, and estimates by the authors.
1/ Latvian prices are those used in the calculation of the CPI in March 1994. Swedish prices were sampled in May 1994.
2/ Excluding alcohol and tobacco.

A Simple General Equilibrium Model

This note shows how the static model above can be extended into a dynamic general equilibrium model which yields numerical solutions. The model described below is of the real business cycle variety, similar to those in for example Asea and Mendoza (1994), Backus and Smith (1993), and Tesar (1992). There are two sectors, the tradable goods sector and the nontradable goods sector. While export and import prices are determined in world markets, the price of nontradables is determined endogenously by market clearing. Both sectors operate under perfect competition and constant returns to scale. For simplicity, production, investment, and consumption decisions are derived assuming an identical technology and preference structure. Thus, the following presentation applies to both sectors. Expectations about future variables are introduced by assuming rational expectations. Approximate decision rules for the model's dynamic behavior are derived from solving the deterministic version of the model assuming perfect foresight.

1. Firms

In each sector, the representative firm produces output Y_t with a Cobb-Douglas production function using capital K_t and labor L_t:

$$Y_t=A_t K_t^{\alpha} L_t^{(1-\alpha)} \qquad 0<\alpha<1$$

The term A_t represents productivity which, in the case of the tradable goods sector, is subject to stochastic shocks (see further below). While productivity may also be subject to a deterministic time trend, it is convenient to work with the model in a detrended form. In what follows, all variables are thus expressed in terms of efficiency units. Employment may be derived explicitly from the representative household's optimization problem. Alternatively, it may be subject to some exogenous process which links it to shocks in productivity depending on the institutional setup of the labor market. However, in the present calculations, employment is held constant in both sectors.

Because of installation costs, the firm only gradually adjusts its capital stock to the desired level. Gross investment I_t includes the change in the capital stock $K_{t+1}-K_t$, installation costs $\gamma((K_{t+1}-K_t)/K_t)(K_{t+1}-K_t)$ and depreciation δK_t:

$$I_t=(K_{t+1}-K_t)+\gamma\left(\frac{K_{t+1}-K_t}{K_t}\right)(K_{t+1}-K_t)+\delta K_t \qquad \gamma>0 \quad \delta>0$$

With r_t denoting the real interest rate, P_t the output price, W_t the wage rate and P_t^I the price index of investment goods, the value of the firm F_t can be written:

$$F_t=E_t[\sum_{s=t}^{\infty}\prod_{v=t}^{s}(\frac{1}{1+r_v})(P_sY_s-W_sL_s-P_s^iI_s)]$$

Given technology and output and input prices, the firm maximizes its expected net present value. The solution to this problem defines investment as a function of the market value of an installed unit of capital relative to its replacement cost q_t which is a function of the expected present value of the marginal product of capital net of depreciation and adjustment costs.

2. Households

There are overlapping generations of households with finite expected lifetimes. In addition, the household may also be subject to adjustment costs and habit persistence. Defined over consumption C_t, expected discounted utility which can be written:

$$E_t[\sum_{s=t}^{\infty}(\frac{\eta}{1+\lambda})^{s-t}U_s] \quad U_t=C_t^{\mu}(C_t/C_{t-1})^{\pi} \quad \eta\leq 1 \quad \lambda\geq 0 \quad \mu\geq 0 \quad \pi\geq 0$$

where η is the survival probability, λ is the subjective discount rate, and μ and π are parameters that reflect the degree of intertemporal substitution and adjustment costs and habit persistence.

With P_t^C being the price index of consumption goods, B_t the household's net debt obligations, and human wealth H_t, the present value of labor income, the expected value intertemporal budget constraint is:

$$E_t[\sum_{s=t}^{\infty}\prod_{v=t}^{s}(\frac{\eta}{1+r_v})P_s^CC_s]=F_t-B_t+H_t \quad H_t=E_t[\sum_{s=t}^{\infty}\prod_{v=t}^{s}(\frac{\eta}{1+r_v})W_sL_s]$$

The household maximizes utility subject to the intertemporal budget restraint. The solution to this maximization problem defines current consumption as a function of past consumption and expected household wealth.

3. Demand for tradable and nontradable goods

In both sectors of the economy, firms and households use a combination of tradable and nontradable goods. Assuming identical parameter values, domestic demand D_t is distributed between tradable and nontradable goods according to a Cobb-Douglas function with unitary elasticity of substitution between the two goods:

$$Y_t^d=(Y_t^t)^{\rho}(Y_t^n)^{(1-\rho)} \qquad 0<\rho<1$$

4. Prices

Foreign and domestic tradable goods are perfect substitutes, implying that terms of trade are both exogenous and constant. As nontradable goods are exclusively used in the domestic economy, the price of nontradable goods is endogenous, determined by market clearing. The present calculations assume that domestic and foreign bonds are perfect substitutes. With a perfectly fixed exchange rate and perfect capital mobility, the economy thus faces a given world market interest rate.

5. Productivity

In the tradable goods sector, productivity is an autoregressive process subject to stochastic shocks:

$$A_t=A_{t-1}+\psi(A_{t-1}-A_{t-2})+u_t$$

where u_t is a serially uncorrelated, normally distributed random variable with zero mean and constant variance, and the term ψ determines the degree of autocorrelation.

6. Solution procedures

Deriving exact solutions under uncertainty for models of this kind is typically requires rather restrictive assumptions with respect to the economy's underlying structure. However, as discussed in Taylor and Uhlig (1990), a number of numerical solution methods exist which make it possible to find approximate solutions when exact solutions are not available. The more advanced methods typically involves discretizing the random variable (if continuous) in combination with value function iteration as in Baxter, Crucini and Rouwenhorst (1990). Other options include Fair and Taylor's (1983) extended path method or the linear-quadratic approximation methods described in Christiano (1990).

Each method has advantages as well as disadvantages. Methods based on value function iteration and discretizing conform more closely with the spirit of the underlying model and are more exact than methods based on approximate decision rules. However, they are also more complicated and therefore more time consuming. Methods based on linear approximations around a deterministic steady state solution require insignificant amount of computing time as they do not involve any type of iterative procedures but have on the other hand a greater potential for errors.

The true model solution requires that expectations are based on the entire probability density of the random variable u_t. This is difficult

considering the model's nonlinearity characteristics. If the model was linear, future values of u_t would cancel out in which case the solution problem becomes easier to handle. However, although the solutions to the optimization problems in the model are generally different under uncertainty than under certainty, this may be of no great consequence for the time series behavior of the model. For this reason, and because it is computationally easier, it is attractive to work with a linearized version of the model. The basic approach taken here is to solve the model deterministically under the assumption that the implications of nonlinearity in combination with nonzero future values of u_t can be ignored.

Even in the deterministic case, the model is too complex to allow for an explicit analytical solution and can only be solved numerically. In the present model, the main problem is to find the exact path for the capital stock K and the shadow price of capital q consistent with optimizing the firm's objective function. Once this problem has been solved, the rest of the model can be solved recursively. The solution to the firm's decision problem is characterized by saddle-point instability. Initially small deviations from the optimal path result in a sequence that eventually diverges away from steady state. It can be shown, however, that a certain path for the shadow price of capital results in an optimal path for the capital stock which gradually approaches steady state. This path can only be approximated through iteration. The calculations in this note are based on solving the model using the extended path method. The basic steps involved can be described as follows.

1. The first step is to calculate a steady state solution which can be used to define terminal conditions for the forward-looking variables. Such a solution requires that all real variables are constant (since the model is defined in terms of efficiency units). It also requires that all relative prices are constant which restricts the choice of parameters underlying consumption behavior. Imposing these conditions yields a steady state value for the shadow price of capital q_S. Unless prices are exogenous, the steady state price of capital must be determined simultaneously with the price of output. It is difficult to do this analytically. However, the model can be iterated to yield a combination of the two prices consistent with a steady state solution.

2. The second step is to choose a terminal period T. The terminal period must be chosen so as to allow for the model to be solved a sufficient number of periods beyond the actual simulation period. In the terminal period, the model is assumed to be in steady state, implying that $q_T=q_S$. Initially, it is also convenient to assume a path $i=q_t,q_{t+1},\ldots,q_{T-1}$ according to which all observations of the shadow price of capital are equal to its steady state value, i.e. $q_t=q_{t+1}=\ldots=q_{T-1}=q_T=q_S$. This yields a starting point for further iterations.

3. The third step is to solve the model in each period using the initial path and the starting values of all predetermined variables. Unless prices are exogenous, this includes finding a set of market-clearing prices in each

period. This is by itself not an entirely straightforward exercise as it involves further iterations. The third step also results in an update of the steady state shadow price of capital.

4. Using the initial path to represent the expected next-period value of the shadow price of capital in each period, the fourth step is to calculate a new path $i+1=q_t,q_{t+1},\ldots,q_{T-1}$ which replaces the old path and is used to represent expectations in the next iteration. The third and fourth steps are repeated until the difference between any two estimates of the shadow price of capital for the same period of two consecutive iterations i-$i+1$ is sufficiently small to meet a convergence criterion.

5. The fifth step is to choose a new terminal period $T'>T$ and repeat the third and fourth steps (including updating $q_T=q_S$) until convergence is reached for the new extended simulation period. The solution period is extended until the difference between any two estimates for the same period of two consecutive solutions for the original solution period 0-T is small enough to meet another convergence criterion.

In order to study the time series behavior of the model, it is convenient to employ a two-step approach. Starting from an initial steady state, it is useful to proceed by examining the response of the model to a standardized unanticipated shock in productivity, by definition equivalent to one standard error (i.e. $u_t=0$ for $t=0,2,3,\ldots,T$ and equivalent to s_A for $t=1$). Once a solution is obtained, the response pattern of the model may be used to derive a moving average process in log differences with a set of weights normalized to represent each variable's dynamic response relative to the underlying productivity process. For example, output is governed by the following process:

$$Y_t=MA_{Y1}u_{At}+MA_{Y2}u_{At-1}+\ldots+MA_{YT}u_{At-T}$$

where $MA_{Y1},MA_{Y2},\ldots,MA_{YT}$ are the moving average coefficients which can be used to infer the relevant variance properties.

Because of the model's nonlinearity characteristics, the result obtained in the first step is to some extent particular to each simulation experiment. Although the effects on the time series properties of each variable relative to the underlying productivity process are quite small, the size of the shock considered in the first step is not entirely unimportant for the results. For example a positive and a negative shock will produce slightly different results also in terms of absolute values even if the shocks are of the same absolute magnitude. However if the firm's decision problem is first linearized before employing the pocedures above, the sign and size of each shock are irrelevant for the final results.

7. Numerical implementation

The low quality of data in the Baltic countries at present severely limits the scope for a very ambitious calibration exercise. Against this background, the model is calibrated so that it broadly reproduces some key ratios and variance properties of six small open economies in Western Europe (Austria, Belgium, Denmark, Finland, the Netherlands, and Sweden) during the period 1971-90 as discussed in Tersman (1992). However, reflecting the expected catching-up process in the Baltic economies, the average rate of growth is assumed to be more than twice as high as in these countries.

With the exception for the parameters underlying the productivity process, all parameters and initial starting conditions are assumed to be identical in the two sectors. In the initial steady state, external trade is balanced, with consumption and investment accounting for 80 and 20 percent of demand and output, respectively (see box below). Consumption and investment are split equally between nontradable and tradable goods. The parameters underlying the household's optimization problem are chosen so as to yield a steady state solution according to which consumption grows in line with output. To take into account liquidity constraints and habit persistence, consumption is subject to the same degree of autocorrelation as the productivity in the tradable goods sector.

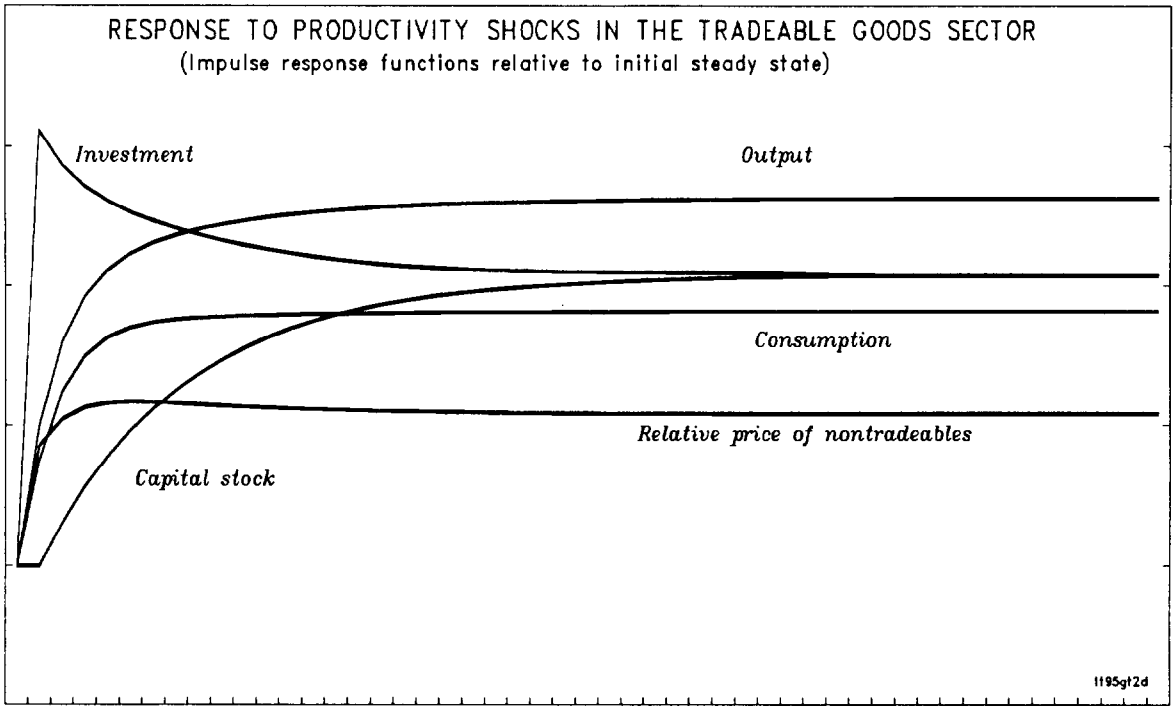
In the tradable goods sector, productivity is subject to stochastic shocks, resulting in fluctuations around the average growth rate. Since productivity is positively autocorrelated, the long-run effect of these shocks is twice as large as the instantaneous one. Given this time series pattern, the distribution of productivity shocks in the tradable goods sector is determined so as to mimic the degree of volatility of the output growth rate observed in the empirical data set (following the procedures described in the previous section). This implies a standard deviation for the rate of growth of total output equal to 75 percent of the average growth rate.

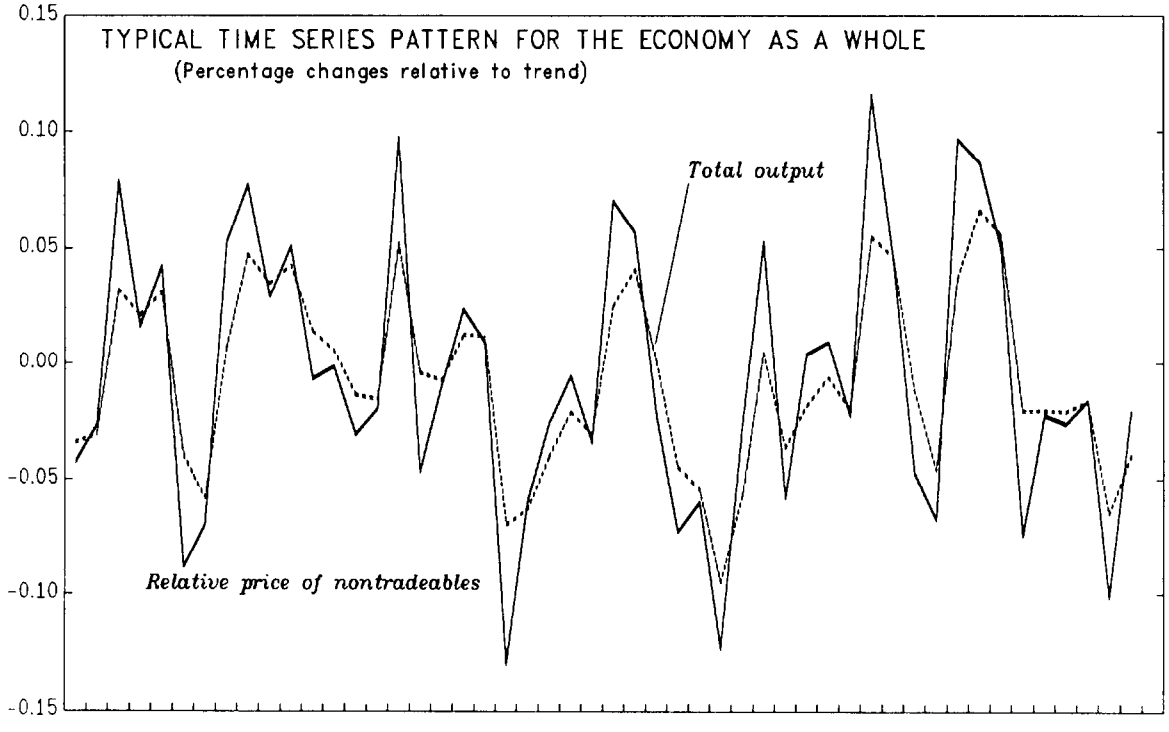
8. Simulation results

Starting from an initial steady-state position, consider a positive shock to productivity in the tradable goods sector. For simplicity, assume that employment in each sector of the economy is constant and unaffected by this shock. In the tradable goods sector, a shock to productivity leads to an increase in profitability, followed by a spike in investment as the capital stock adjusts to its optimal level (Chart 6). Because of the increase in productivity, as well as the adjustment in the capital stock, there is also a gradual increase in output, which induces an increase in consumption. Part of the increase in income in the tradable goods sector will be directed towards demand for nontradable goods. Because productivity in the nontradable goods sector is unchanged, the relative price of nontradable goods must rise. This, in turn, induces further adjustments in the tradable goods sector. The end-result is a slightly hump-shaped response in the relative price of nontradable goods.

CHART 6

RELATIVE PRICE OF NONTRADEABLES AND THE RESPONSE TO PRODUCTIVITY SHOCKS





While the output response of the nontradable goods sector is similar to that of the tradable goods sector, it is less pronounced. Because of this, in a stochastic environment with repeated productivity shocks, output and demand in the nontradable goods sector are generally less volatile than in the tradable goods sector. Model simulations show that there is a very close correlation between aggregate output and the relative price of nontradable goods (as well as between output and demand). The theoretical elasticity of the relative price of nontradables with respect to aggregate output is close to 0.8 (or 0.4 for the overall price level) but this obviously depends on the model's parameters, particularly the degree of substitutability between tradable and nontradable goods.

Parameter Values in the Tradable and Nontradable Goods Sectors and Initial Steady State Values

Parameter values	
α Share of capital in output	0.30
γ Investment adjustment cost factor	1.50
δ Depreciation rate	0.10
η Time horizon factor	1.00
λ Time preference rate	0.05
μ Intertemporal elasticity of substitution factor	0.00
π Consumption adjustment cost factor	0.50
ρ Share of nontradable goods in investment and consumption aggregates	0.50
ψ Persistence of productivity process	0.50
r Real interest rate	0.05
Properties of Growth Process and Initial Steady State Values (in percent)	
Growth rates	
Tradable goods sector	8.0
Nontradable goods sector	4.0
Total economy	6.0
Relative price of nontradable goods	4.0
Standard deviations of detrended changes in logs relative to total output	
Consumption	100.7
Investment	371.6
Capital stock	64.0
Relative price of nontradable goods	138.2
Share of total output in initial steady state	
Consumption	80.0
Investment	20.0
Nontradable goods	50.0

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