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Essays on monetary integration, inflation, and trade competitiveness in transition countries

Ainura Uzagalieva

Dissertation

Prague, October 2006

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Preface

This dissertation contains three essays focused on macroeconomic issues in the Commonwealth Independent States (CIS). Two essays, which analyse recent monetary and inflation issues in the CIS, contribute to empirical studies in the area of monetary economics of countries under transition. The third essay explores, formally and empirically, a link between labor market regulations and international trade and proposes a possible area of trade specialization for a number of countries as, for example, landlocked economies in Central Asia (CA). The important theoretical point to be gained from this essay is that there are very clear reasons for international trade between similar or identical countries, even between markets that are competitive. Namely, the rational for international trade can be based on, apart from the standard concept of differences in productivities, differences in labor market regulations among countries.

In recent years tendencies to coordinate economic policies among CIS countries have strengthened. One of the examples is a project for the creation of a Common Monetary Area (CMA) among Belarus, Kazakhstan, and Russia. Integration within this context will inevitably deprive the policymakers of monetary policy instruments and seigniorage revenues obtained by the governments from their central banks. Moreover, due to the diversity of law enforcement in collecting taxes and the general macroeconomic environment, which result in different size of seigniorage revenues obtained in the pre-integration period, there will be a fiscal effect across the countries with different patterns and size. In this context it is very important to understand the pattern of these changes as these changes will play a crucial role in negotiations among the member states for the rules regulating the distribution of seigniorage wealth brought about by the common monetary area. Thus, the main focus of this essay is on the role, real scale, and sources of central bank earnings and transfers to the budget and the welfare effect of monetary integration. Moreover, in the pre-integration period, it is particularly vital to investigate how policymakers could increase budgetary revenues from central bank seigniorage and credibly commit to low inflation. These problems are addressed in the first essay.

The next issue, interesting both from a research viewpoint and policy implications for CIS countries, is the link between labor market regulations and the competitive

position of countries in international trade. Today the largest net exporters in the CIS are Kazakhstan and Russia, other countries with permanent trade proficits are Azerbaijan, Turkmenistan and Ukraine and the rest have permanent trade deficits.[1] In other words, even if CIS countries are engaged in international exchange of goods, their exports include, mainly, minerals and energy resources (e.g. Turkmenistan). So, an important question is what the possible area of specialization in international trade, especially for low-income CA economies, would be. Based on formal and empirical analysis presented in the second essay, we argue that proper regulations towards higher flexibility of labor markets and market competition can create additional comparative advantages, in particular in producing goods with unstable demand (e.g., fashionable fabrics, clothes, and toys), and improve competitive position in international markets. This is because differences in labor market flexibility between countries affect their competitive positions in international markets and can serve as an independent cause of international trade.

In light of the CMA creation, preferences in macroeconomic management are given to gradual economic convergence. Other CIS countries can join the area if they accept the agreement requirements and meet the macroeconomic criteria set within the CMA. In these circumstances it becomes very important for policymakers to prudently commit to the policy of macroeconomic stability including a credible policy of low inflation. In this respect, the majority of CIS countries announced their intentions to switch monetary policies from instrumental methods based on the consumer price index (CPI) towards inflation targeting based on core inflation. However, core inflation, which is defined as the sustained change of prices that reflects long-term price movements, has not yet been thoroughly studied in these economies. In this respect, the second essay, which analyzes the alternative methods of measuring core inflation in the Kyrgyz Republic (KR), where the dynamic of CPI is characterized by high volatility and irregular fluctuations due to a strong impact of exogenous factors[2], contributes to the current research in this area.

[1] Source: The International Bank for Reconstruction and Development/The World Bank (IBRD/WB), 2005: World Development Indicators (WDI).

[2]Important sources of exogenous shocks are exchange rate fluctuations, high dependence on energy products, changes in the state-controlled prices and tariffs.

The first essay was published in Post-Communist Economies [Uzagalieva A., (2005) Fiscal Consequences of Monetary Integration within a Common Economic Area: the Case of Belarus, Kazakhstan and Russia, Vol. 17, No.4, pp. 399-424]. The preliminary version of this paper appeared in the CERGE-EI Working Paper Series, No. 254 (April 2005) under the same title. The second essay, which is "Labor Market Flexibility, International Competitiveness and Patterns of Trade," is forthcoming in Economia Internazionale/International Economics. The preliminary version of this paper is forthcoming in the CERGE-EI Working Paper Series under the same title. The third essay, which is "Finding Optimal Measures of Core Inflation in the Kyrgyz Republic", was published in Problems of Economic Transition [Uzagalieva A., (2006) Optimal Measures of Core Inflation in Kyrgyzstan, Vol.49, No.3, pp. 6-53]. The preliminary version of this paper was published in the Economic Education and Research Consortium (EERC)-Russia Working Paper Series, No. 67 in 2004 both in Russian and English languages and the updated version was published in the CERGE-EI Working Paper Series, No. 261 (May 2005).

Fiscal Consequences of Monetary Integration within the Common Economic Area: the Case of Belarus, Kazakhstan and Russia*

Ainura Uzagalieva**

The aim of this paper is to analyze the possible impact of planned monetary integration on public sector revenues from seigniorage in Belarus, Kazakhstan and Russia. Using the concept of *total gross seigniorage*, we investigate the main sources and uses of the central bank revenues in these countries. Special attention is given to the role of seigniorage revenues in financing public sector expenditures. Amounts of yearly transfers from central banks to the state budget in Belarus, Kazakhstan and Russia are evaluated, and the size of potential gains and losses in seigniorage revenues under different scenarios of monetary integration are estimated.

Keywords: seigniorage, monetary integration, transition economies

JEL Classification: E 52, E56

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1. Introduction

Given the limited success of market reforms in individual economies, tendencies to coordinate economic policies among Commonwealth Independent States (CIS) countries have strengthened in recent years. The most prominent example of such a trend is a project for the creation of a common monetary area (CMA) including Belarus, Kazakhstan, and Russia. Belarus and Russia have already taken the first step in this process. Both countries signed an agreement on the Common Emission Center (CEC) of the Russia-Belarus Union on November 30, 2000, stating that a new currency, the ruble of the Union State, will be introduced as legal tender in Russia and Belarus starting from January 1, 2008. During an intermediate period, from January 1, 2006 to December 31, 2007, the Russian ruble will circulate as a single currency in both countries. Signing the Government Decree on the Concept of Financial System Development by the government of Kazakhstan on July 28, 2003, was another important step towards monetary integration. According to this Concept, Kazakhstan intends to start preparing to join the CMA in 2005. It is assumed that monetary integration will take place in 2011.

Expected monetary integration among three CIS countries raises important issues related to fiscal and monetary policies since the influence of factors, which underlie the inefficiency of the tax system and revenue motives for monetary expansion, is strong. A large shadow economy,[3] which is not possible to tax, and underdeveloped capital markets, at which governments cannot sell large amounts of treasury bills, strengthen the public-finance motives of seigniorage obtained by a central bank (Koreshkova 2003). The creation of the CMA will deprive the national policymakers of monetary policy instruments and change the redistribution of seigniorage revenues. Consequently, it will have budgetary consequences with different patterns and magnitudes across the countries since the size of the seigniorage, which is transferred by the central banks to their governments, is not the same. In this respect, it is important to investigate the magnitude of seigniorage transfers to the state budget in a pre-integration period, analyze the country-specific features of institutional and monetary environment, and estimate the welfare impact of monetary integration. These issues are critical because they would play

[3]The average size of the black market during 2000-2001 is about *47%* of GDP in Belarus, *42%* of GDP in Kazakhstan, and *45%* in Russia (Schneider 2002).

a crucial role in negotiations among the member states for the rules regulating the distribution of seigniorage wealth within the CMA.

The importance of seigniorage revenues in the context of monetary integration was already recognized in a number of studies related to the creation of a common currency area in the European Union (EU) (see Cukrowski and Fischer 2002; Feist 2001; Schobert 2001; Sinn and Feist 1997, 2000). In particular, due to cross-country differences in banking regulations and the level of accumulated seigniorage wealth, monetary integration will result in large welfare transfers among the member states of the European Monetary Union (EMU) (Sinn and Feist 1997, 2000). The authors found that among fifteen EU member states, countries with a more liberal banking sector like France and the UK (e.g., with low reserve-deposit ratio) would gain. However, countries like Germany, Austria, and Spain would lose as they are characterized by less liberalization of banking sectors with high reserve requirements. Further studies (Cukrowski and Fischer 2002) that focused on the new EU member states suggest that if the current mechanism of seigniorage wealth distribution does not change, virtually all countries, except the Czech Republic, will gain by joining the euro zone. This can be explained by a seigniorage distribution mechanism (see Section 4), in particular, by the fact that the new EU member states are relatively poor compared to the countries of the euro area, and therefore, their population shares will be larger than their respective GDP shares in the EMU. Larger capital shares in the European Central Bank (ECB) relative to the share of a country's seigniorage wealth in a common pool will allow them to receive a larger portion of it.

The general economic environment as well as the institutional features of central banks in CIS countries are different from that in EMU accessing countries. So, the main components of the central bank revenues and the welfare impact of monetary integration in the conditions of CIS countries deserve special attention. The aim of this study is to analyze sources and uses of the central bank's seigniorage in Belarus, Kazakhstan, and Russia, taking into account specific features of the monetary environment as well as central bank institutional arrangements and the potential welfare effect caused by monetary integration in each country. The analysis is based on official documents (e.g., financial sector legislation and the annual reports of the central banks) characterizing central bank operations during 1997-2003. Potential welfare gains or losses from

monetary integration are estimated assuming three possible mechanisms of seigniorage wealth redistribution among the member states of CMA: (1) redistribution proportional to accumulated seigniorage wealth; (2) redistribution according to the mechanism used in the EMU; and (3) redistribution according to economic potential of the member states.

2. A total gross seigniorage concept: components and measures

Theoretical and empirical studies (Fischer 1982; Friedman 1971) consider seigniorage revenues as the main economic argument in favor of national currencies that determines the desire of a country in choosing a domestic currency over a foreign one. This argument is also important for countries considering either to integrate in monetary unions or to adopt official dollarization (or eurization, rublification) by substituting their national currencies. The following basic concepts of seigniorage are distinguished in the literature. *A conventional monetary concept* is based on the idea that a government can finance its spending through direct loans from a central bank, creating high-powered money in the form of non-interest bearing currency (Fischer 1982; Friedman 1971; Haslag 1998; Schobert 2001). *An opportunity cost concept* is associated with an optimal tax approach which implies that the higher the costs of collecting taxes the higher the seigniorage is (Honohan 1996; Klein and Nuemann 1990; Schobert 2001). Under this concept, the government finances its spending through issuing and selling interest bearing bonds rather than through issuing non-interest bearing currency. *A fiscal dominance concept* is the situation when government sets fiscal plans, determines the level of seigniorage for financing the budget revenues irrespective of monetary policy objective, and thus strongly influences decision-making in the central bank (Honohan 1996; Sargent and Wallace 1981). And *a fiscal concept* joins all the mentioned approaches into a single approach as a general measure of seigniorage revenue (Drazen 1985, 1989; Honohan 1996; Klein and Neumann 1990; Neumann 1996; Schobert 2001).

Drazen (1985) suggests that each of the above-mentioned measures is a special case which relates to specific monetary and fiscal policy experiments and conditions. He distinguishes between the financing and taxation aspects of monetary expansion and focuses on the net revenues that fiscal authorities receive from monetary operations. These operations are related not only to the creation of a monetary base but also to the

management of the central bank. It also takes into account previous monetary expansions, which continue to accrue government assets that provide present yields. This difference was especially stressed by Cukrowski and Fischer (2002); Cukrowski and Janecki (1998); Cukrowski and Stavrev (2001); Klein and Neumann (1990) and Neumann (1996) and developed further as *a total gross seigniorage concept*. In particular, Neumann (1996) showed formally that this concept generalizes the above-mentioned concepts and allows one to analyze seigniorage in the broadest possible sense as the sum of all revenues resulting from the monopoly power of the central bank to manage its base money.

The variety of seigniorage concepts determine different ways of measuring seigniorage revenues. Also, the process of generating and using seigniorage revenues in a particular country depends on country-specific features, in particular, on the legal, institutional, and operational arrangement of the central bank (Drazen 1985). The actual independence of the central bank is especially important in this aspect since an independent central bank can prevent government from financing inflationary budget expenditures. Empirical evidence shows that in CIS economies, central banks are characterized by a limited degree of independence (Maliszewski 2000), although legally almost all of them are considered independent. For instance, the central banks of Belarus, Russia, and Ukraine have the least political independence among *20* transition economies[4] with the political indexes estimated at *5*, *5*, and *3*, respectively.[5] Limitations on the amount of credit from the central bank to its government to correspond with key factors determining *economic* independence are almost non-existent in Belarus and the Ukraine. Although legislation in Russia and Kazakhstan prohibits the central banks to finance their governments, in some cases this requirement is overlooked.

Obviously, given the different degree of central bank independence across countries and consequently, the variety of monetary environments, the practice of obtaining seigniorage revenues varies as well. In this respect, the *total gross seigniorage*

[4]The sample covers former Soviet countries: Armenia, Belarus, Estonia, Georgia, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, and the Ukraine and Central European countries: Albania, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia.

[5]The indexes of political and economic independence ranges from *2* to *9* in this study. The index of political independence is determined by the relationship of the central bank with its government, the procedure of appointing the board of the central bank, and a formal goal of the central bank. In countries with sound political independence of the central bank, this index is high (e.g., *8* in Kyrgyzstan, 8 in the Czech Republic, and *7* in Poland).

concept, which analyzes seigniorage in the broadest possible sense as the sum of all revenue flows from the central bank to the government, takes into account not only operations related to monetary base but also other activities including the management of the central bank and its relations with the government. Therefore, this concept implies a more detailed analysis of the mechanism underlying the creation and allocation of seigniorage revenues than usual, taking into account the country-specific features of monetary environment and the institutional arrangements of the central bank. In comparison to other concepts, this is the only one that allows the proper inter-country comparison of seigniorage revenues created by the central bank.

Nuemann (1996) specifies the *total gross seigniorage* (s) as

(1) $$s = s^M + s^I + s^{OP} + s^{RI}.$$

The first term of this expression, s^M, denotes *monetary seigniorage*, which is a change in the real, i.e. deflated by the general price level, stock of monetary base (ΔM)[6]. Monetary seigniorage is defined as

(2) $$s^M = \frac{\Delta M}{p} = \frac{\Delta M}{M} m \ ,$$

where p denotes the general price level and m – real balances. The second term, s^I, denotes *net interest revenues* accrued on the stock of non-government debt deflated by the general price level, and it is expressed as

(3) $$s^I = \frac{i^P A^P + i^F A^F}{p} \ ,$$

where A^P denotes the *net claims* of the central bank to the domestic private sector and A^F – the *net foreign assets* of the central bank; the terms, i^P and i^F, correspond to nominal interest rates, respectively. The third term (s^{OP}) describes *net revenues* from the central bank's operations deflated by the general price level

(4) $$s^{OP} = \frac{G}{p},$$

[6]"Δ" denotes a change within a year.

where G stands for net revenue. Finally, s^{RI} denotes *book gains* due to a change in the value of net foreign assets resulting from exchange rate movements. This term is defined as

(5)
$$s^{RI} = \frac{L}{p} = \frac{\Delta e A^F}{ep},$$

where L denotes a book gain, and e – exchange rate.

As it was noted by Cukrowski and Janecki (1998); Cukrowski and Stavrev (2001); and Cukrowski and Fischer (2002), empirical studies based on the monetary seigniorage concept usually only approximate actual seigniorage flow from the central bank to the government. This stems from two simplified assumptions: one is that the government receives seigniorage revenues irrespective of the legal and institutional regulations existing between the government and the central bank; and another is that the amount of seigniorage revenues transferred to the government is independent of the specificity of the monetary environment. The authors argue that such a simplification does not take into account the cost of money production, which can be very large,[7] nor the existence of the central bank as a whole. Neumann (1996) shows that the central bank uses seigniorage for covering its expenses on money creation and operating activities (s^C); investments in non-government debt (s^{NI}); transfers to the state budget (s^G); and financing its own capital and reserves or payments to third parties (s^O):

(6)
$$s = s^C + s^{NI} + s^G + s^O \ .$$

In the expression (6), the costs on money creation and operating activities are defined as the sum of the cost of printing notes (C^{Bn}) and the cost of maintaining operations (C^{CB}) deflated by the general price level:

(7)
$$s^C = \frac{C^{Bn} + C^{CB}}{p} \ .$$

[7]As Klein and Neumann (1990) showed from 1974 to 1987, about 16.9% of German monetary seigniorage was used to cover the Bundesbank´s operating costs.

The central bank holding of non-government debts is defined as the change of the net claim to the domestic private sector (ΔA^P) and the net foreign assets (ΔA^F) as

(8) $$s^{NI} = \frac{\Delta A^P + \Delta A^F}{p} \ .$$

The expressions for determining budget financing (s^G) and an increase in central bank capital and reserves are:

(9) $$s^G = \frac{\Delta A^G + (R^G - i^G A^G)}{p}, \text{ and}$$

(10) $$s^O = \frac{R^O}{p}, \text{ respectively.}$$

In the expression *(10)*, R^O denotes profit transferred to third parties or used for reserves and capital accumulation.

Following Neumann (1996), the part of the seigniorage transferred to the state budget s^G (specified by expression [*9*]) is called *fiscal seigniorage*. The government receives fiscal seigniorage through net borrowing from the central bank (ΔA^G) and taking the profits of the central bank net of interest payments earned on the stock of government debt (R^G - i^G A^G). Consequently, fiscal seigniorage can be fully determined by expression *(9)*, taking into consideration the country-specific features as well as the details of the legal, institutional, and operational arrangements of the central bank.

3. Sources and uses of seigniorage in Belarus, Kazakhstan, and Russia (empirical results)

The concept presented in the preceding section views seigniorage from two important angles: creation and distribution. This section deals with the empirical estimation of the sources and uses of seigniorage in three countries: Belarus, Kazakhstan, and Russia in a period 1997 to 2003. Specific features of the monetary environment and the institutional arrangements of the central banks in each country are described. The sources of the data are International Finance Statistics (IFS) and the annual reports of central banks for the period 1997 to 2003, which contain the balance sheet records of central bank assets and liabilities and financial statements of income and expenditures of the central banks (Table 1 in Appendix). The sources and uses of seigniorage revenues

are calculated at annual frequency in terms of national currencies and expressed as a fraction of GDP for the purpose of comparison across the countries.

The results of estimations indicate that the size of central bank seigniorage revenues (total seigniorage) is quite high in all countries under consideration (Table 2 in Appendix). The average value of seigniorage obtained by the central banks of Belarus, Kazakhstan, and Russia during 1997 to 2003 are *4.3%* of GDP, *5.1%* of GDP, and *5.7%* of GDP, correspondingly. These values are larger than the average size of seigniorage estimated during 1971-1990 in *78* countries[8] (Click 1998), which rank from less than *0.5%* GDP to about *4.0%* of GDP.

The year by year change of seigniorage in Belarus, Kazakhstan, and Russia shows that in all three countries it increased drastically in 1998 and 1999, approaching the upper boundary (*10.1%* of GDP) in the ranking of *42* developing countries by the average of seigniorage during 1974-1985 (De Haan, Zelhost, and Roukens 1993). So, the total seigniorage reached *8.5*% of GDP in 1998 in Belarus; in Kazakhstan – 6.7% of GDP in 1999; and in Russia – *9.8%* of GDP in 1998. This was the result of a financial crisis in Russia in 1998, where the annual inflation rate reached *84.4%*, currency depreciated by *4* times, foreign reserves declined by *31.3%*, output fell by *4.6%*, and the budget deficit was to *8.2%* of GDP. The Russian crisis heavily influenced the economies of Belarus and Kazakhstan, causing during the year, a very large decline in foreign trade (by *19.6%* and *7.0%*, respectively); an exchange rate depreciation (by *5.6* and *1.5* times, respectively); and an increase in the annual inflation rates (to *351.2%* and *17.8%*, correspondingly).

The comparison of total seigniorage revenues suggests that during 1997-1999, the manner of collecting seigniorage revenues by the central banks was similar across the countries under consideration. Namely, in this period monetary seigniorage is a main part of seigniorage revenues. For example, at the end of 1999 the monetary seigniorage component reached *74.1%* of the total seigniorage revenues in Belarus; *34.0%* in Kazakhstan[9]; and *85.8%* in Russia. From 1998 to 1999 the book gain component, which

[8] Click (1998) investigated seigniorage in a cross-section of *90* countries over the period 1971-1990. Countries with the largest size of seigniorage are Israel with *14.8 %* of GDP, Yugoslavia with *11.9%* of GDP, Chile with *10.3%* of GDP, Argentina with *9.7%* of GDP, and Nicaragua with *7.9%* of GDP.

[9] A relatively small size of monetary seigniorage in the total seigniorage revenue of Kazakhstan in 1999 was due to a large increase in the book gain component of seigniorage (it reached *52.8%* of total seigniorage). This result was due to strong exchange rate depreciation.

is just an increase in the recorded value of foreign reserves in terms of national currencies, resulting from an exchange rate depreciation was also very large reaching *26.3%* of total seigniorage in Belarus; *52.8%* in Kazakhstan; and *41.7%* in Russia.

In all subsequent years (i.e., from 2000 to 2003), however, the ways of obtaining total seigniorage differs across the countries. The government sectors of Kazakhstan and Russia, for instance, increased the amounts of their oil-related funds held in their central banks which, correspondingly, contributed to the decrease in government debt. The government funds contributed to the total seigniorage revenues with about *3.8%* of GDP in Kazakhstan and *1.2%* of GDP in Russia on average during 2000 to 2003. The total seigniorage of Belarus declined during these years from *5.3%* of GDP in 1999 to *2.2%* of GDP in 2003 (Table 2 in Appendix) due to a strict monetary policy (monetary seigniorage declined from *3.9 %* of GDP in 1999 to *1.6%* of GDP in 2003).

The structure of seigniorage by distribution, on the contrary, is characterized by a more diverging pattern across countries. While the central bank of Belarus was using seigniorage revenues mainly for financing the state and public sectors throughout the whole period considered, the central banks of Russia and Kazakhstan were using it, especially after the crisis of 1998, for their investing activities and financial reserves and capital. In order to examine to what extent the central banks were financing their governments, a more detailed overview of seigniorage uses with a brief description of the general economic, monetary and legal environment in each country are presented below.

3.1. Belarus

The banking system of Belarus consists of the central bank, named the National Bank of the Republic of Belarus (NBRB), and commercial banks, about *80*% of which are owned by the state.[10] Legally the institutional status of the NBRB is recognized to be independent from the government and state agencies. However, in practice such independence is very limited both politically and economically. In particular, the chairman of the NBRB, who is appointed by the president, must necessarily be a member of the government. Moreover, in its lending activity the NBRB acts not only as the lender

[10] See EBRD Transition Report 2004.

of last resort for banks, but also as a creditor to the government,[11] providing it with direct loans in compliance with the budget law.

Data presented in Table 2 (in Appendix) demonstrates that the central bank in Belarus used a relatively large portion of its seigniorage revenues for financing the government budget in the years of 1997 to 1999. The size of fiscal seigniorage is especially large in 1998 when the NBRB transferred to the government the amount equivalent to *5.3%* of GDP. During 1999-2003, the amount of the NBRB's fiscal transfers to the government gradually decreased. It fell from *3.5%* of GDP in 1999 to *1.3%* of GDP in 2001, and in 2002, it switched from a positive to a negative number (*-1.1%* of GDP) due to the large reduction (by *64.2%*) of government obligations towards NBRB during the year. The reason for this was that the government of Belarus privatized a gas transporting and distributing company (Beltransgaz) in 2002 under the condition of an agreement with Russia giving to Belarus an access to natural gas from Russian Gazprom at internal prices in Russia. So, an increase in privatization revenues from *1.2%* of GDP to *2.8%* of GDP during the year allowed the government to finance about *72.0%* of its fiscal deficit without relying on the revenues of the central bank. In addition, reforms in the energy sector, namely, an increase in the tariffs of gas and energy for households (by *2.9* times), which were assigned to raise the cost recovery of enterprises, contributed to the increase of tax collections (by *0.3%* of GDP) in 2002. As a result, the net claim of the central bank to the government was reduced during the year.

Difficulties with the balance of payments (Table 3 in Appendix) did not allow the government to rely much on the external sources of budget financing in 2003. So, the net foreign financing of the budget deficit decreased from *15.1* mln. USD in 2002 to *-8.8* mln. USD in 2003. Besides, the slow speed of structural reforms and privatization did not allow any improvement the in collection of tax revenues and privatization receipts, which increased by *0.1%* GDP only during the year. So, persisting difficulties in the area of government finance caused the NBRB to increase the amount of fiscal transfers in 2003 again. It reached *1.0%* of GDP indicating the fact that the NBRB is required to provide the government with funds for financing the budget deficit (*1.2%* of GDP)[12] through

[11] See "Banking Code of the Republic of Belarus" passed by the House of Representatives on October 3, 2000 and approved by the Council of the Republic on October 12, 2000.

either extending direct credits or purchasing government bonds at the primary market or both. The scale of the fiscal seigniorage transferred by the NBRB to the government during 1997-2003 is presented in Figure 1.

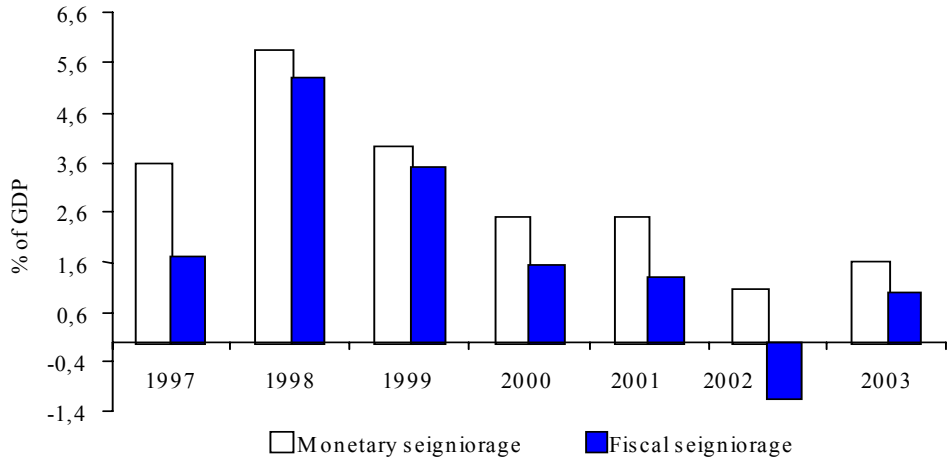

Figure 1. Belarus: monetary and fiscal seigniorage

Figure 1 reveals that the NBRB used for financing its budget deficit revenues generated through money creation. Furthermore, as Table 2 shows, the NBRB used the largest part of its seigniorage revenues, especially from 1997 to 1998 (about *3.1%* of GDP), for extending credits to private or the non-governmental sector of the economy. In almost all years except 1999, a primary component of seigniorage use is net investment or an increase in the holdings of the central bank of private (i.e., non-government) domestic and foreign debt.

It needs to be stressed that one has to be very careful when using the word "private" as a descriptor for the net investments of the central bank in non-government debt instruments because the private sector in Belarus includes not only privately owned enterprises, but also state-owned enterprises as well as the household sector. Here we have to mention that according to official documents,[13] the NBRB was expected to provide directed credits to the private sector upon the requests of state organizations

[12] See Law of the Republic of Belarus "On the Budget of the Republic of Belarus" for the period 1998 to 2003.
[13] See Annual reports of the NBRB for the period 1998 to 2003.

during the whole period considered. The directed credits were assigned for such purposes as housing, development of the agricultural sector, support of agricultural production, seeds purchasing, salary payments for the workers of state enterprises, state emergency, and trade. Therefore, the definition of private sector in Belarus might be vague and thus, should be extended to a broadly defined public sector.

Since the central bank with limited autonomy has been required to extend credits directly to enterprises or commercial banks upon a direct order from the government, the real scale of public sector transfers is very large.[14] However, the exact size of the public enterprise sector deficit cannot be measured precisely due to data limitations[15] and estimating the size of quasi-fiscal operations of the central bank is beyond the scope of this study. The fiscal seigniorage and net investment of NBRB in non-governmental debt, which results from quasi-fiscal operations, is compared with the monetary seigniorage in Figure 2.

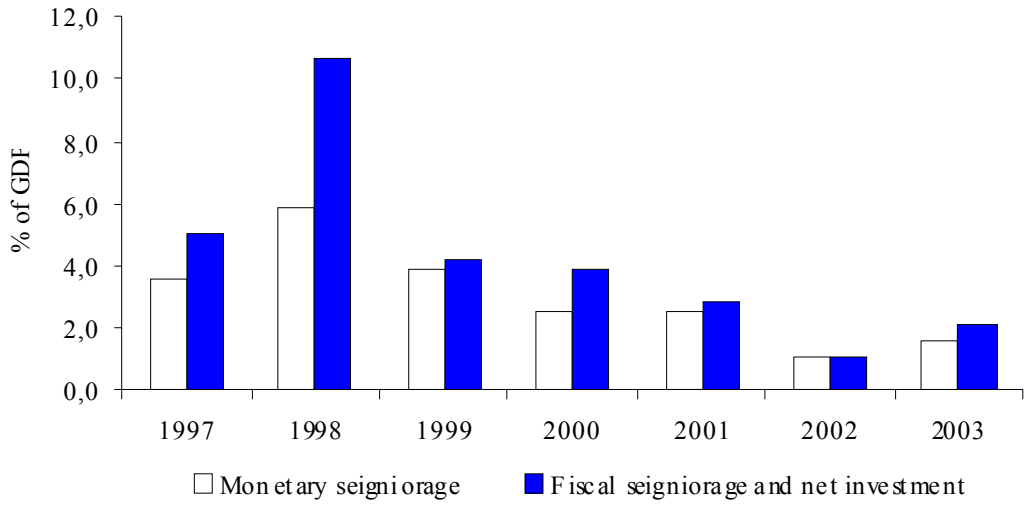

Figure 2. Belarus: monetary seigniorage versus fiscal seigniorage and net investment

Obviously, revenues from money creation were not enough, especially in 1998, to cover fiscal and quasi-fiscal (investment) expenditures of the NBRB, so it used its revenues

[14]The quasi-fiscal deficit, which reflects large directed credits to the public sector and state enterprises, reached *11.1%* of GDP in 1999 (Markiewicz 2000).
[15]According to the International Monetary Fund, the size of quasi-fiscal operations has been high in recent years too, however information on the deficit of public enterprises is under the direct control of the presidential administration and publicly not available (see IMF Country Report No.04/141, May 2004).

earned on financial operations for covering the remaining part of such expenditures. Table 2 suggests that the revenues obtained from financial operations are about *0.6%* of GDP from 1997 to 2003 on average in Belarus, so the central bank of Belarus must be using other sources of financing. According to the results presented in the Table 2 (in Appendix), when the difference between the monetary seigniorage and fiscal and quasi-fiscal investments of the central bank is very large, the amount of funds used for the accumulation of capital reserves and third party transfers (the s^O item) is negative. These suggest that the NBRB either decreased the size of its capital and reserves or used transfers from third parties for financing the fiscal seigniorage and its investments, or both. Presumably, it was converting the private or, more precisely, the non-governmental sector debt to the government sector.

3.2. Kazakhstan

Legislation stipulates the main principles of central bank independence in Kazakhstan, however there exists a channel that limits its actual independence in practice. In particular, legislation emphasizes that the National Bank of Kazakhstan (NBK) should operate independently, should act as a bank, financial adviser, and agent of the government bodies, and the state and government agencies have no right to interfere in its operations.[16] Furthermore, the NBK should not provide the government with direct financing.[17] However, the structure of the NBK's management, which consists of two boards – a supervisory board, the highest administrative body, and the board of directors – attracts special attention. In particular, the supervisory body, which is responsible for authorizing legal acts drafted by the NBK on major policy directions as well as on the main operational activities, consists of nine members including representatives delegated by the president and the government. As a result, state bodies can directly influence the decision-making process of the NBK on both major policy and operational issues. Therefore, in comparison to the central bank of Belarus, the central bank of Kazakhstan has a higher degree of autonomy, but its decision-making process can be influenced by the government.

[16] See the law "On the National Bank of the Republic of Kazakhstan" No. 2155, March 30, 1995.
[17] The practice of extending direct credits to the government for financing the budget deficit was banned in 1998.

The allocation of seigniorage revenues indicates that the size of fiscal seigniorage obtained by the government of Kazakhstan directly from the central bank is small. As Table 2 (in Appendix) shows, the highest level of fiscal seigniorage (*0.3%* of GDP) was collected in 1998 and the lowest (*-6.6%* of GDP) in 2001. We should note that in all years, except 1998, the values of the fiscal seigniorage in Kazakhstan were negative.

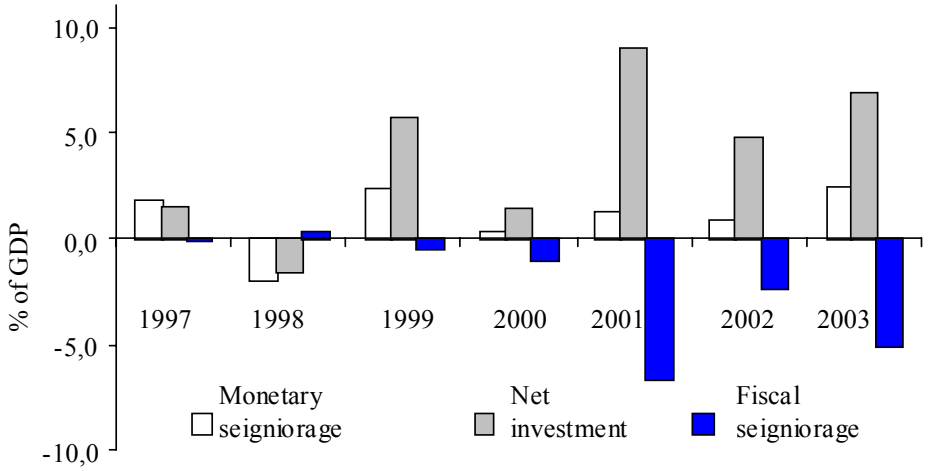

Figure 3. Kazakhstan: monetary seigniorage versus net investment and fiscal seigniorage

In other words, the NBK acted as a debtor rather than a creditor of the government. In this respect, the structure of the net investment component of the NBK deserves special attention.

Generally, the activity of the NBK during the period considered in this study was highly responsive to the government policies since the supervisory board, which authorizes the major policy guidelines and operational activities of the NBK, includes the government as well as presidential representatives. In particular, the government priorities to strengthen investment activities in the economy and to support the business sector are reflected in the reporting system of the NBK.[18] As Table 2 (in Appendix) illustrates, the net investments of the NBK are the largest portion of seigniorage usage during 1997 to 2003, reaching almost *3.9%* of GDP, on average. The peak level of this component is indicated in 2001 (*9.1%* of GDP) due to a large increase (by *1.8* times) in

[18] See, for example, the Annual Report of the NBK for 2000, 2001, and 2002.

the foreign reserves of the NBK. Since about a half of this inflow is from government funds, namely, oil-related funds and others state revenues (e.g., privatization receipts, rent payments for cosmodrome "Bajkonur"), fiscal seigniorage was the lowest (*-6.6%* of GDP). In addition, the NBK extended large credits[19] to the banking sector and various institutions both in domestic as well as foreign currencies to deal with one of the state priorities, to support the business sector of the country. It should be noted that major receivers of these directed credits were gold-mining companies and small- and medium-sized enterprises. So, the large net investments of the NBK have resulted from the inflows of government foreign reserves and credits extended to the real sector directly through the banking system.

Apart from foreign reserves held by the government, the NBK was also using government securities for its investment activities. Namely, it was acquiring the ownership of bonds issued by the Ministry of Finance of the Republic of Kazakhstan (MFRK) upon their placement in the primary market. In addition, it was issuing short-term notes, which are called "government securities issued by the NBK,"[20] both in domestic and foreign currencies with its privilege to specify all procedures and conditions on their selling and buying. Consequently, the NBK was transforming the government debt instrument into its own debt either through buying government securities with an ownership or issuing new securities on its own behalf and placing them in the primary market. This is another reason for a year by year reduction in the net claims of the NBK on the government and a negative sign of fiscal seigniorage.

3.3. Russia

The banking system of Russia includes the Central Bank of Russia (CBR), founded on July 13, 1990 and commercial banks. Unlike Belarus and Kazakhstan, where the governors of the central bank are accountable to the president, the chairman of the CBR is accountable to the Parliament of Russian Federation (RF). The Parliament

[19]The volume of credits extended by commercial banks to the real sector increased by *77.3%* in 2001 reaching *14%* of GDP, of which *3.6%* of GDP were directed to small- and medium-sized enterprises (see Annual Report of the NBK for 2001).

[20]See Article 36-2 of the law "On the National Bank of the Republic of Kazakhstan" No. 2155, March 30, 1995.

appoints and dismisses the chairman of the CBR on requests made by the president of Russia and the board of directors of the CBR. According to legislation, a key element of the legal status of the CBR is the principle of independence; the central bank should fulfill its functions independently from federal, regional, and local government bodies. However, as in the case of Kazakhstan the organization structure of the CBR's administration has a channel that might limit the actual independence of the Bank.

The management of the CBR consists of the collegiate body and the board of directors. The collegiate body, which includes the chairman of the CBR and officials from the president, government, parliament, and legislative organs, is responsible for reviewing reports of the CBR and authorizing proposals for main policy guidelines. The board of directors, which consists of the chairman and twelve members appointed by the parliament at the recommendation of the chairman, deals with monetary policy in collaboration with the government and decision-making on operational and managerial issues. Although legislation stipulates the segregation of duties between these two bodies,[21] the influence of state agencies on the decision making process in the CBR is not excluded since all major policy and operational guidelines are the subject of approval by the highest body (e.g., the collegiate body).

Legislation prohibits the central bank to finance directly and indirectly the government budget through extending loans and buying government securities in the primary market. However, in some cases the federal budget law can overlook this rule.[22] To demonstrate this, a comparison of the fiscal seigniorage and the monetary seigniorage of the CBR during 1997-2003 is presented (Figure 4).

[21] The members of the collegiate body except the chairman of the CBR are prohibited from working in the CBR on a full-time basis and, consequently, being paid for their work in the body. The members of the board of directors, in their turn, are prohibited from participating in political parties, religious organizations, the civil service, parliament, legislative and government bodies.

[22]The Article 22 of the Law on the CBR stipulates: "The Bank of Russia shall not be entitled to extend loans to the Russian Federation Government to finance the federal budget deficit and buy securities at their primary placement, except for those cases stipulated by the federal budget law."

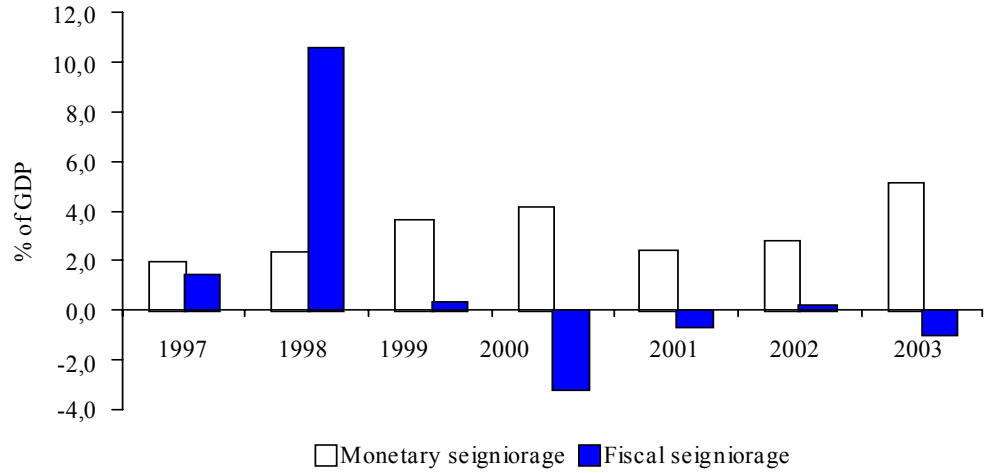

Figure 4. Russia: monetary and fiscal seigniorage

As Figure 4 shows, during the first two years (i.e., in 1997 and 1998) the CBR was extensively financing the government budget and only with the beginning of macroeconomic stabilization, which started in 1999 (Table 3 in Appendix), has the amount of seigniorage to the government decreased from the central bank.

In 1997 the federal budget deficit reached *6.5%* of GDP and the primary source of funds for the federal budget came from the CBR in the form of monetary seigniorage (*1.9%*). In particular, the operations of the CBR on the security market with government bonds were the major source of fiscal transfers: buying government bonds at the primary market contributed about *20%* to budget transfers, and placing bonds in the secondary market contributed about *80%*. It should be noted, however, that the government debt on bonds[23] became the largest portion (*87.2%*) of its total domestic debt in 1997. With the instability of world financial markets, which caused a decrease of foreign investments to emerging markets including Russia, the internal crisis factors in Russia (e.g., budget deficit, large government debts, and depreciation of ruble) were intensified to such an extent that the government was no longer able to service its debt. On August 17, 1998, the Ministry of Finance of RF (MFRF) failed to meet its principal payments on government bonds and the government announced a default, suspending all its payments

[23] Short term government bonds (GKO) and federal loan bonds (OFZ).

on bonds. As a result, the CBR stopped trading on both primary and secondary security markets. Government bonds[24] issued before August 1998 were converted into eurobonds and restructured.

In the second half of 1998, the federal budget no longer received any revenues from government securities. As a result, the budget deficit, which reached *8.2%* of GDP in 1998, was financed, primarily, from the foreign reserves of the CBR, and the MFRF ran up a huge debt to the CBR on operations with government bonds. At the end of the year the amount of MFRF's outstanding debt to the CBR rose to *208.6* billion rubles (or *7.7%* of GDP). The budget crisis (e.g., the government default, accumulation of a huge government debt, and the lack of funds to repay it) increased the dependence of monetary policy on the fiscal situation; fiscal seigniorage of the CBR reached its peak level (*10.6%* of GDP) in 1998. It was financed by foreign reserves which caused a reduction of net investment by *3.8%* of GDP; monetary seigniorage (*2.3%* of GDP); third party transfers and reserves (*1.9%* of GDP); and net interest revenues (*0.1%* of GDP). It should be noted that the remaining *2.9%* of fiscal seigniorage was due to the book gains component. This is because the portfolio of the CBR included debt instruments in foreign currency such as government loan bonds[25] and direct credits to the governments. Obviously, a sharp fall in the exchange rate against the USD (by *4* times) during the year increased the recorded value of these obligations in terms of the ruble, which amounted at the end of the year to about *169* bln. rubles (or *8.2* bln. USD). Thus, large depreciation of the ruble against the USD was reflected as a book gain component in fiscal seigniorage as well since a large portion of MFRF's outstanding debt to the CBR was in foreign currency.

The size of the fiscal seigniorage declined from *10.6%* of GDP in 1998 to *0.3%* of GDP in 1999 due to improvements in the field of government finance. The budget deficit in this period declined from *8.2%* of GDP to *3.1%* of GDP; however, difficulties in collecting taxes remained, and the MFRF continued to finance the budget deficit by monetary borrowing from the CBR. The central bank was buying from the MFRF, federal bonds under non-market conditions (e.g., without interest payments and on a

[24] The government securities such as short-term bonds (GKO) and federal loan bonds (OFZ) issued in July, 1998 were converted into eurobonds (see Annual Report of the CBR for 1998).
[25] These obligations included the government loan bonds issued in foreign currency (OVGVZ); eurobonds issued in 1996 to 1998; and bonds issued by the MFRF for GKO restructuring.

long-term basis with maturing dates from 2014 to 2023)[26] and extending credits in foreign currency (*4.5* bln. USD) to help the government service its foreign debt in time. Since the government began to restructure its debt incurred on securities issued earlier, a large part of federal loan bonds on the balance sheet of the CBR was due from 2018 to 2029 with either low interest (*2%* p.a.) or no interest at all. At the end of the year, the debt of the MFRF to the CBR amounted to *513.5* billion rubles (*7.4%* of GDP) of which *33.9%* (about *174.1* bln. rubles) were obligations in foreign currency.

In 2000, the size of fiscal seigniorage transferred from the central bank to the government switched from a positive (*0.3%* of GDP in 1999) to a negative number (-*3.2%* of GDP in 2000). This was caused by positive changes in the government finances, namely, a budget surplus (*3.1%* of GDP) that allowed the MFRF to meet its debt obligations without extensive borrowing from the CBR. The budget law, however, stipulated that the CBR would provide the government with *30* billion rubles (*0.4%* of GDP) through buying government securities at the primary market and with *1* billion USD through extending direct credit to the MFRF for foreign debt repayments. At the same time, the activation of investment activities in the economy and general banking stabilization allowed the central bank to increase its net investments to the private sector, which reached *7.6%* of GDP by the end of 2000.

In 2001 the MFRF and the CBR completed the restructuring of government securities in the portfolio of the CBR into federal loan bonds. The years 2002 and 2003 were of relatively high economic performance (the growth rate of GDP reached *4.3%* and *7.3%* and the budget surplus without grants reached *0.6%* of GDP and *1.1%* of GDP, respectively). This allowed the MFRF to pay its debt obligations both in ruble and dollar denominations to the CBR. In 2003, the magnitude of fiscal seigniorage was small (-*0.1%* of GDP) and negative, indicating the fact the government restructured the government debt obligations into federal loan bonds without borrowing from the central bank.

[26] See the Annual Report of CBR for 1999.

4. The welfare effect of monetary integration for Belarus, Kazakhstan, and Russia

Planned monetary integration among the three countries considered in the paper will redistribute accumulated seigniorage wealth and will generate a significant welfare effect in each country. The pattern and size of this effect will be different across the countries. In this section, we look more closely at possible ways to distribute seigniorage wealth[27] in CMA and the potential gains or losses to be taken by each member country. Presumably, the distribution of seigniorage wealth created by CMA or, more precisely, the stake of seigniorage, which each country is going to receive after integration, will be determined by the initial endowment of a country in the equity capital of CEC. Therefore, the size of an equity share, which each participating country contributes to CEC, can be an important matter in negotiations towards integration. Below we consider three possible scenarios of determining equity shares and seigniorage division.

Scenario I. The equity share of a member country is proportional to its weight in the total level of seigniorage wealth created by all countries by the time the common currency area is established and the central banks are no longer responsible for their monetary policies as separate institutions. Thus, seigniorage wealth is determined based on two balance sheet variables which stand just before the day the central bank joins the common currency area: the amount of monetary base minus interest bearing central bank reserves held by private banks. The intuition behind this scenario is that the amount of seigniorage wealth, which is collected in the pre-integration period, already reflects the level of seigniorage desired by the government since it depends on the rate of monetary expansion chosen by policymakers.

Scenario II. The distribution of seigniorage revenues is similar to the case of seigniorage distribution in the EMU. In the case of the EMU, the distribution of seigniorage created by the ECB or, more precisely, the stake of seigniorage, which each member-country receives, is determined by the initial endowment of a country in the equity capital of the ECB. The equity share[28] of a member state in the ECB is determined

[27]Seigniorage wealth is determined as the difference of the monetary base, which contains cash money circulated in the economy and central bank reserves held by the private banking system, and the portion of the private bank reserves on which the central bank pays interests.

[28]The distribution of seigniorage wealth generated by the EMU among its member states is regulated by the Protocol on the "Statue of the European System of Central Banks and the ECB" (see articles 32.2 and 32.5).

as the average contribution of GDP (in constant prices) and population values to the total GDP and population in the euro-zone. Therefore, the size of the equity share, which each member-country of the CMA will contribute to the CEC, can be treated as an important matter of negotiations towards integration in the case of CIS countries.

Scenario III. This scenario is an adaptation of European rules to the conditions of CIS because given the fact that CIS countries have a large degree of state regulations and shadow economies, unlike EMU members, GDP in constant prices might not be relevant for this study. Therefore, we use GDP adjusted by Purchasing Power Parity (PPP) instead of GDP in constant prices and compare the real economic potential of CIS member countries. In order to calculate the equity shares of CIS member states in the CMA, the average GDP (adjusted by PPP) for the period 2000 to 2003 expressed in US dollar and population value for 2003 are used. We use the average value of GDP over the period 2000 to 2003 in order to smooth short-term shifts.

The share of interest bearing private bank assets (e.g., time deposits, security repurchase [REPO] operations), which are held in the central bank and accrue interest, in the monetary base is quite low in all countries (less than *2-3%* of the monetary base on average during the analyzed period). In contrast, mandatory reserve requirements which force private banks to keep a part of their assets in the central bank are large. In particular, the required reserve-deposit ratio in all three countries significantly exceeds the threshold level (*4%*) which distinguish, according to Sinn and Feist (1997), a highly regulated banking system.[29] This suggests in all three countries the liquidity of private banks for commercial financial operation is very limited.

However, preparations towards integration may involve some liberalization and development of the banking sector which will lead to an increase in the portion of interest bearing reserves in the monetary base and in the liquidity of commercial banks. This implies that the share of each country in the total seigniorage wealth will change from the current state, and the pattern of this change will depend on the degree and speed of banking liberalization. If the banking sectors in three countries are liberalized with different degrees and speeds, this will change the composition of the monetary base in

[29]In more liberal banking systems the reserve-deposit ratio usually does not exceed *2%* (Feist and Sinn 1997).

terms of interest bearing and non-interest bearing private bank reserves and will eventually alter the share of each country in total seigniorage wealth. In this respect, a simplified rule of seigniorage distribution described in Scenario 1, which is based on seigniorage wealth created by the three countries in an environment of a highly regulated banking system, will not be preferred. So most probably, the basic scheme of integration among CIS countries will look like the EMU version of integration since the main policy strategies towards CEA and CMA are very similar to EU and EMU guidelines.[30]

The welfare effect of CMA under Scenario 2 is determined as the difference of the equity and seigniorage weights of its member country multiplied by the total amount of seigniorage wealth accumulated by all countries by the end of 2003. Consequently, the size of countries in terms of population and GDP, which determine the size of equity share, on the one hand, and the amount of seigniorage wealth generated in the pre-integration period, on the other, would be important elements of the welfare effect. The equity shares of participating countries calculated according to our three scenarios are presented in Table 1.

[30] See Concept on the Establishment of the Common Economic Area of September 19, 2003 (draft in Russian).

Table 1. Equity shares of CIS member states in the CMA

Scenario 1	Seigniorage wealth, as of end of 2003 (mln. national currencies)	Exchange rates: as of end of 2003 BYR/USD, KZT/USD, and RUR/USD	Seigniorage wealth, as of end of 2003 (mln. USD)	Share in seigniorage wealth (%)	Equity share in CMA (%)
Belarus	1 629 204	2 156.00	756	1.18	1.18
Kazakhstan	308 144	144.22	2 137	3.34	3.34
Russia	1 796 900	29.45	61 006	95.47	95.47
Total	#	#	63 898	100.00	100.00
Scenario 2	Population (mln. people)	GDP (constant 1995), average in 2000-2003 (bln. USD)	Population (share, %)	GDP (share, %)	Equity share in CMA (%)
Belarus	9.88	14.34	5.87	3.84	4.86
Kazakhstan	14.91	24.00	8.86	6.43	7.64
Russia	143.43	335.14	85.26	89.73	87.50
Total	168.22	373.49	100.00	100.00	100.00
Scenario 3	Population (mln. people)	GDP by PPP (constant 1995), average in 2000-2003 (bln. USD)	Population (share, %)	GDP by PPP (share, %)	Equity share in CMA (%)
Belarus	9.88	46.23	5.87	4.11	4.99
Kazakhstan	14.91	69.86	8.86	6.21	7.54
Russia	143.43	1 008.37	85.26	89.68	87.47
Total	168.22	1 124.46	100.00	100.00	100.00

Sources: National Statistic Committees of Belarus, Kazakhstan, and Russia; Annual Reports of the NBRB, the NBK, and the CBR

As Table 1 demonstrates under Scenario 1, when countries are assumed to contribute to the common emitting center the accumulated seigniorage wealth, Russia has the largest equity share (*95.5%*) and Belarus the smallest (*1.2%*).

In Scenario 2, under which the equity shares are calculated similar to EMU rules, the share of Russia is somewhat smaller (*87.5%*), while the shares of Belarus and Kazakhstan increase significantly from *1.1%* to *4.9%* and *3.3%* to *7.6%*, respectively. This is because both population and GDP shares of Belarus and Kazakhstan, unlike those of Russia, are much larger than their corresponding shares in the total seigniorage wealth accumulated by all countries. Under Scenario 3, where GDP adjusted by PPP is used, the equity share of Russia is almost the same as in the previous case (*87.5%*). However, a small increase in the weight of Belarus by *0.1%* contributes to an increase in its welfare

gains by *86.4* million USD. Correspondingly, a decrease in the weight of Kazakhstan (by *0.1%*) leads to a decrease in its welfare gain by *68.4* mln. USD.

Based on estimated values of the equity share, the pattern and scale of the welfare effect in each participating country is presented in Table 2.

Table 2. Welfare effect of monetary integration

	Equity share in CMA (%)	Seigniorage wealth in 2003 (mln. USD)	Share in seigniorage wealth (%)	Total gain (mln. USD)	Gain per capita (USD)
Scenario 2					
Belarus	4.86	755.66	1.18	2 347.72	237.62
Kazakhstan	7.64	2 136.62	3.34	2 748.04	184.31
Russia	87.50	61 005.96	95.47	-5 095.76	-35.53
Total	100.00	63 898.24	100.00	0.00	#
Scenario 3					
Belarus	6.06	755.66	1.18	2 434.16	246.37
Kazakhstan	8.59	2 136.62	3.34	2 679.67	179.72
Russia	85.35	61 005.96	95.47	-5 113.83	-35.65
Total	100.00	63 898.24	100.00	0.00	#

Sources: Annual Reports of the NBRB, the NBK, the CBR, and the author's calculations

According to the results, which are based on a comparison of the equity shares of participating countries with their corresponding seigniorage shares in CMA, Russia would lose in all considered scenarios, while Kazakhstan and Belarus would gain. As Table 2 reveals, the loss to be taken by Russia is quite large with an estimate of about *5* bln. USD in both alternative scenarios. Kazakhstan and Belarus, on the contrary, would enjoy a big welfare gain. In particular, the sizes of a welfare gain per capita to be taken by Belarus and Kazakhstan are *237.6* USD and *184.3* USD under Scenario 2 and *246.4* USD and *179.7* USD under Scenario 3, respectively.

One of the reasons for welfare transfers among countries within a monetary union is related to the existence of differences in banking regulations and the level of seigniorage wealth collected during the pre-integration period (Sinn and Feist 1997, 2000). Specifically, a country with a highly regulated banking system and with strict requirements to private banks usually loses when it integrates with a country where

private banks have more flexibility to manage their liquidity. This is because in the environment of strict regulations the amount of reserves, which is required by the central bank, is high relative to the opposite case. As a result, the share of a country in the total seigniorage wealth of integrating countries is significantly larger than its equity share in the common emitting center, and the welfare effect is always negative. In contrast, a country with a more liberal banking system usually gains since its monetary base is not significantly large compared to countries with a more regulated banking system.

Large welfare transfers among countries can also stem from differences in national wealth (Cukrowski and Fischer 2002). This is because the population share of poorer countries in a monetary union are much larger than their respective GDP shares; consequently, their larger capital shares relative to the share of seigniorage wealth in a common pool will allow them to receive a larger portion of seigniorage. Along with the size of countries in terms of population and GDP and differences among countries in banking regulations, welfare transfer between economically large and small countries takes place also because of political reasons (Casella 1992).

5. Conclusion

In light of a recent trend in the CIS towards monetary integration among Belarus, Kazakhstan, and Russia, the present paper analyzis the importance of seigniorage revenues in these countries during 1997 to 2003, possible ways to distribute seigniorage in the CMA, and the expected welfare effect of monetary integration. The concept of total gross seigniorage, which allows one to analyze seigniorage in the broadest possible sense as the sum of all revenue flows from the central bank to the government, is applied. Namely, we explored and compared across three countries the process of generating and allocating seigniorage (e.g., its four main sources and uses), taking into account the legal, institutional, and operational arrangements of their central banks and giving special attention to the magnitude of fiscal seigniorage transferred to the government. Based on three alternative scenarios of seigniorage division among the member countries of the CMA, the distribution of gain or loss across countries is estimated.

Empirical results reveal that the manner of collecting seigniorage revenues by the central banks is similar across the countries (monetary expansion is a main source of

seigniorage revenues and revenues obtained on interest earnings and financial operations are low). The structure of seigniorage in terms of its distribution is a bit different both across countries and time. Before 1999, the monetary authorities of Belarus and Russia used a large portion of their seigniorage revenues for financing the state budget while the central bank of Kazakhstan used it for reserve funds. From 1999 onwards, the magnitude of fiscal seigniorage shows a declining tendency (especially in Russia). The comparison of fiscal seigniorage across countries after 1999 suggests that the government of Belarus, which gives its central bank very limited autonomy, more strongly relies on seigniorage revenues to finance its state budget than in Kazakhstan and Russia. In these countries, the situation is different since those governments obtain substantial revenues from the oil sectors and central banks have more political and economic independence.

The analysis of a welfare impact of monetary integration suggests that Russia would shoulder a welfare loss while Kazakhstan and Belarus would gain substantially. This is because the share of Russia in the seigniorage wealth of all countries is much larger than its equity share in the capital of CEC. This finding is consistent with earlier findings (Cukrowski and Fischer 2002) that show a large disparity in the economic size translates to a transfer of seigniorage wealth from large to small countries (the smaller the country is in terms of GDP and population, the larger the amount of welfare gain). Welfare transfer among three countries can be interpreted in the context of distribution of power over common decisions in monetary union (Casella 1992), which is left for further research. Results presented in this paper should be useful in negotiations among the member states towards integration and in the determining rules regulating the distribution of seigniorage wealth in the common area.

Appendix: Tables

Table 1. Balance sheets and financial statements of the central banks of Belarus, Kazakhstan, and Russia

Belarus							
Balance sheet (mln.rubles, as of end of the period)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Assets							
Foreign assets	12 333	76 465	98 355	423 560	706 179	1 439 900	1 788 900
Domestic assets, claims on:							
-government	14 448	54 930	153 755	302 799	504 345	190 416	643 263
-resident credit institutions	17 046	51 229	60 226	107 082	180 557	255 447	332 130
Other assets	172	365	2 085	7 547	12 577	17 019	23 521
Total assets	43 999	182 989	314 421	840 988	1 403 658	1 902 782	2 787 814
Liabilities							
Foreign liabilities	9 791	70 720	81 722	245 979	344 175	593 814	650 394
Domestic liabilities							
Banknotes in circulation	12 300	27 074	86 852	238 796	512 211	650 020	926 438
Government funds	2 010	6 490	15 072	41 741	35 100	22 569	126 677
Funds of resident credit Institutions	12 915	39 227	97 828	175 539	332 744	466 270	760 352
Other liabilities	23	81	139	306	757	2	186
Total liabilities	37 038	143 591	281 614	702 361	1 224 987	1 732 675	2 464 047
Capital and reserves	3 694	5 968	24 895	129 194	185 695	311 865	474 978
Other items(net)	3 266	33 430	7 912	9 433	-7 024	-141 758	-151 211
The sum of liabilities	43 999	182 989	314 421	840 988	1 403 658	1 902 782	2 787 814
Financial report (mln.rubles, flow per year)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Interest incomes	1 773	4 059	13 919	30 496	82 124	66 314	93 819
Interest payments	-1 850	-3 812	-8 132	-13 900	-18 648	-29 763	-57 651
Net interest incomes	-77	246	5 787	16 596	63 476	36 551	36 167
Other net incomes	4 149	4 458	35 914	28 605	22 390	63 943	82 718
Income before provision for losses	4 072	4 704	41 701	45 201	85 866	104 921	119 230
Provisions for possible losses	-970	-1 892	-3 378	-8 399	-13 042	-4 978	-864,2
Operational income (after using provisions for losses)	3 103	2 812	38 323	36 801	72 823	99 943	118 366
Operational expenses, including:							
staff expenses;	-321	-661	-2 578	-8 000	-17 139	-25 615	-31 685
depreciation;	-48	-97	-229	-1 627	-4 887	-13 986	-15 036
banknotes and coin issue;	-1	-110	-1 794	-1 695	-1 447	-1 929	-3 777
Administrative expenses	-237	-488	-2 888	-6 728	-24 235	-29 760	-34 229
Transfers to the budget	-1 331	-1 206	-15 727	-16 291	-12 558	-13 977	-16 819
Net profit after transfer payments	1 165	250	15 107	2 460	12 558	13 977	16 819

Kazakhstan

Balance sheet (mln. tenges, as of end of the period)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Assets							
Foreign assets	172 971	164 663	276 713	302 950	565 816	788 081	1 241 530
Domestic assets, claims on:							
- government	77 078	87 931	109 304	41 568	19 133	19 230	2 946
- resident credit institutions	8 248	2 084	4 634	2 774	1 810	3 758	3 150
Other assets	620	7 277	12 657	2 146	3 586	4 060	6 349
Total assets	258 918	261 954	403 308	349 438	590 345	815 129	1 253 975
Liabilities							
Foreign liabilities	42 409	56 354	66 097	286	346	390	6 543
Domestic liabilities							
Banknotes and coins in circulation	92 796	68 728	103 486	106 428	131 174	161 701	238 730
Government funds	53 647	59 766	93 899	57 507	256 768	356 425	570 924
Funds of resident credit institutions	22 593	12 700	23 263	27 988	44 377	46 470	78 142
Other liabilities	6 872	12 093	7 313	49 882	18 547	65 304	205 763
Total liabilities	218 318	209 641	294 058	242 090	451 212	630 290	1 100 102
Capital and reserves	52 611	63 480	121 957	118 963	134 371	179 834	167 299
Other items (net)	-12 012	-11 167	-12 707	-11 615	4 761	5 005	-13 424
The sum of liabilities	270 929	273 121	416 015	361 053	585 583	815 129	1 253 978
Financial report (mln.tenges, flow per year)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Interest incomes	5 628	5 654	7 813	17 126	29 373	21 446	15 538
Interest payments	-3 701	-3 058	-4 555	-4 775	-11 453	-6 448	-12 597
Net interest incomes	1 927	2 595	3 257	12 351	17 920	14 998	2 941
Other net incomes	3 159	3 107	8 582	17 165	16 706	47 578	-1 742
Income before provision for losses	5 087	5 702	11 839	29 516	34 626	62 576	1 199
Provisions for possible losses	-185	-1 294	-3 805	-16 010	-9 761	-5 834	12 606
Operational income (after using provisions for losses)	4 902	4 409	8 034	13 507	24 865	56 741	13 805
Operational expenses, including:							
staff expenses;	-719	-977	-1 144	-2 086	-2 766	-2 878	-3 221
depreciation;	-456	-686	-425	-1 414	-664	-1 028	-1 104
banknotes and coin issue;	-602	-229	-654	-786	-1 118	-1 085	-2 736
other administrative expenses	-2 719	-2 316	-2 671	-2 404	-1 506	-1 557	-1 713
Transfers to the budget	-406	-109	-3 202	-5 795	-6 234	-10 519	-5 691
Net profit after transfer payments	0	91	-63	1 022	12 576	39 674	-660

Russia

Balance sheet (mln. rubles, as of end of the period)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Assets							
Foreign assets	123 344	286 324	383 899	842 445	1 163 850	1 615 680	2 391 100
Domestic assets, claims on:							
- government	226 049	525 374	572 030	504 702	488 102	551 547	477 640
- resident credit institutions	11 119	76 438	202 944	206 501	250 187	223 991	198 742
Other assets	327	562	430	367	248	2 239	2 319
Total assets	360 839	888 698	1 159 303	1 554 015	1 902 387	2 393 457	3 069 801
Liabilities							
Foreign liabilities	79 744	401 551	424 201	331 056	287 413	233 030	220 638
Domestic liabilities							
Banknotes and coins in circulation	130 474	187 679	266 146	418 871	583 839	763 245	1 147 040
Government funds	21 313	41 863	75 872	240 488	294 914	357 878	446 001
Funds of resident credit institutions	79 976	75 996	173 597	320 887	367 455	500 485	800 670
Other liabilities	240	1 828	1 575	7	2	29	5
Total liabilities	311 747	708 917	941 391	1 311 309	1 533 623	1 854 667	2 614 354
Capital and reserves	69 552	118 113	151 844	166 048	242 312	364 731	298 727
Other items (net)	-20 460	61 668	66 068	76 658	126 452	174 059	156 720
The sum of liabilities	360 839	888 698	1 159 303	1 554 015	1 902 387	2 393 457	3 069 801
Financial report (mln. rubles, flow per year)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Interest incomes	2 056	4 072	4 399	27 848	36 549	46 914	44 862
Interest payments	-1 089	-1 774	-7 489	-10 337	-8 124	-8 189	-3 083
Net interest incomes	967	2 298	-3 090	17 511	28 425	38 725	41 779
Other net incomes from financial operations	14 968	3 324	48 839	46 508	59 905	47 914	64 143
Income before provision for losses	15 935	5 622	45 749	64 019	88 330	86 639	105 922
Provisions for possible losses	-2 966	-12 537	-19 486	-31 497	-26 367	0	0
Operational income (after using provisions for losses)	12 969	-6 915	26 263	32 522	61 963	86 639	105 922
Operational expenses, including:							
staff expenses;	-7 463	-8 601	-11 113	-13 727	-21 055	-28 870	-29 196
banknotes and coin issue;	-1 098	-1 930	-1 550	-2 207	-2 597	-2 767	-3 139
other administrative expenses;	-1 621	-10 383	-12 415	-12 409	-20 228	-22 628	-18 859
Transfers to the budget	-1 985	0	-593	-2 090	-9 042	-24 923	-29 806
Net profit after transfer payments	802	-27 829	592	2 089	9 041	7 451	24 922

Sources: IFS (2004), Annual Reports of the NBRB, the NBK, and the CBR

Table 2. Sources and uses of seigniorage in Belarus, Kazakhstan, and Russia (% of GDP)

	1997	1998	1999	2000	2001	2002	2003
Total seigniorage (s_t)							
Belarus	4.68	8.48	5.26	3.41	3.29	2.82	2.21
Kazakhstan	2.39	2.63	6.61	2.17	9.07	5.21	7.81
Russia	2.59	9.80	4.27	7.70	4.22	4.02	6.93
The sources of seigniorage							
Monetary seigniorage (s^M)							
Belarus	3.56	5.85	3.91	2.51	2.51	1.04	1.59
Kazakhstan	1.86	-1.96*	2.25	0.29	1.27	0.86	2.44
Russia	1.94	2.25	3.67	4.10	2.43	2.77	5.14
Net interest revenues (s^I)							
Belarus	-0.02*	0.04	0.19	0.18	0.37	0.14	0.10
Kazakhstan	0.12	0.15	0.16	0.48	0.55	0.40	0.07
Russia	0.04	0.09	-0.06*	0.24	0.32	0.36	0.31
Net revenues from CB operations (s^{OP})							
Belarus	0.87	0.37	1.08	0.22	0.05	0.24	0.23
Kazakhstan	0.18	0.10	0.24	0.04	0.21	1.11	0.24
Russia	0.51	-0.35*	0.61	0.21	0.37	0.44	0.48
Book gains (s^{RI})							
Belarus	0.25	2.23	0.09	0.49	0.35	0.30	0.29
Kazakhstan	0.15	0.82	3.49	0.37	0.41	0.49	-1.32*
Russia	0.10	4.09	-0.70*	-0.02*	0.41	0.45	-0.76*
The uses of seigniorage							
The costs of printing notes and maintaining operations (s^C)							
Belarus	0.17	0.19	0.25	0.20	0.28	0.27	0.24
Kazakhstan	0.27	0.24	0.24	0.26	0.19	0.17	0.20
Russia	0.43	0.80	0.52	0.39	0.49	0.50	0.38
Net investment (s^{NI})							
Belarus	3.26	5.34	0.71	2.33	1.53	2.16	1.04
Kazakhstan	1.55	-1.56**	5.71	1.43	9.06	4.71	6.93
Russia	0.47	-3.38**	4.19	7.62	4.63	4.34	5.73
Reserves, capital and transfers from(-)/to(+) parties (s^O)							
Belarus	-0.48**	-2.36**	0.80	-0.64**	0.19	0.39	-0.09**
Kazakhstan	0.58	0.15	0.66	0.48	-0.18**	0.33	-0.64**
Russia	0.22	-1.95**	-1.47**	-0.33**	-0.90**	-1.05**	0.05
Fiscal seigniorage (s^G)							
Belarus	1.71	5.30	3.50	1.52	1.29	-1.10**	1.02
Kazakhstan	-0.09**	0.28	-0.47**	-0.98**	-6.63**	-2.36**	-5.06**
Russia	1.47	10.60	0.27	-3.15**	-0.69**	0.23	-0.99**

*) Negative values relate to the uses of seigniorage

**) Negative values relate to the sources of seigniorage

Source: IFS (2004), Annual Reports of the NBRB, the NBK, and the CBR, and author's calculations

Table 3. Macroeconomic indicators in Belarus, Kazakhstan, and Russia during 1997-2003

	1997	1998	1999	2000	2001	2002	2003
Belarus							
GDP growth (annual %)	11.40	8.40	3.40	5.80	4.70	5.00	6.75
Inflation (annual %)	63.92	72.89	293.68	168.62	61.13	42.54	28.40
Overall budget balance including grants (% of GDP)	-1.56	-0.85	-1.99	-0.08	-1.90	-1.80	-1.20
Money and quasi money growth (annual %)	111.36	276.00	132.65	219.27	58.86	53.52	56.81
Current account balance (% of GDP)	-6.09	-6.66	-1.60	-2.54	-3.51	-2.64	-3.00
Net capital account (mln.USD)	133.20	170.10	60.40	69.40	56.30	52.70	68.9
External debt, total (mln.USD)	1171.20	10110	886	898	1142	1439	1438
Exchange rate (BYR/USD, end of the period)	30.74	220.00	320.00	1 180.00	1 580.00	1 920.00	2 156.00
Kazakhstan							
GDP growth (annual %)	1.70	-1.90	2.70	9.80	13.50	9.80	9.20
Inflation (annual %)	17.39	7.12	8.31	13.16	8.36	5.85	6.80
Overall budget balance (% of GDP)	-3.58	-8.10	-5.20	-1.00	-0.90	0.30	-0.90
Money and quasi money growth (annual %)	24.06	-14.13	84.37	44.96	40.20	30.06	29.27
Current account balance (% of GDP)	-3.61	-5.53	-1.01	3.69	-5.01	-2.82	-0.23
Net capital account (mln USD)	-439.80	-369.10	-234.00	-290.60	-194.02	-119.90	-28.79
External debt, total (mln. USD)	4 078.00	9 932.00	12 081.40	12 685.40	15 158.20	18 201.30	22 859.00
Exchange rate (KZT/USD, end of the period)	75.55	83.80	138.20	144.50	150.94	155.85	144.22
Russia							
GDP growth (annual %)	0.90	-4.90	5.40	9.00	5.00	4.30	7.3
Inflation (annual %)	14.74	27.67	85.68	20.75	21.49	15.79	15.10
Overall budget balance, Including grants (% of GDP)	-6.50	-8.24	-3.10	3.10	2.70	0.60	1.10
Money and quasi money growth (annual %)	27.96	37.47	56.64	58.42	36.08	33.93	38.54
Current account balance (% of GDP)	-0.02	0.08	12.56	18.04	10.83	8.63	8.28
Net capital account (bln.USD)	-0.79	-0.38	-0.33	10.95	-9.35	-12.39	-0.99
External debt, total (bln.USD)	127.62	185.66	177.10	158.30	150.40	153.20	182.10
Exchange rate (RUR/USD), end of the period	5.96	20.65	27.00	28.16	30.14	31.78	29.45

Source: the Ministry of Finance of Belarus, the Ministry of Finance of Kazakhstan, the Ministry of Finance of Russia, World Development Indicator (2004), IFS (2004), EBRD Transition Report (2004)

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Labor Market Flexibility, International Competitiveness and Patterns of Trade

Ainura Uzagalieva*

The paper focuses on the question of how labor market regulations can affect a country's competitive position in international trade and international trade patterns. The analysis shows that differences in labor market flexibility between countries affect their competitive positions in international markets and can serve as an independent cause of international trade. It is argued that an increase in labor market flexibility may change the relative price of goods within the country making it more competitive in international markets for commodities with uncertain demand. Changes in relative prices can alter countries' comparative advantage and thus international trade patterns. Furthermore, it is shown that due to the differences in relative prices resulting from different labor market regulations, international trade between countries can be observed even if they are identical in all respects (e.g., labor productivity and production technology). Data reveal that a country with a more flexible labor market has comparative advantage in, and tends to export, goods with more variable demand (e.g., fashionable clothes, seasonal toys), while a country with a more rigid labor market has a comparative advantage in, and tends to export, commodities with more stable demand.

JEL Classification: F100, D800

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1. Introduction

International trade plays a key role in the strategies of poverty reduction, economic growth and affects overall national development. In many cases, however, geographical location, high transportation costs or the lack of advanced technologies do not allow countries to benefit from international exchange. There exist regions where countries with similar technological levels, climate conditions and regulatory framework, lacking a clear comparative advantage, compete with each other on international markets and, except for some trade in natural resources, cannot fully explore benefits of international exchange within and outside the region.

Most of the factors (e.g., geographical location, high transportation costs, climate conditions, and the lack of advanced technologies) that affect countries' comparative advantage cannot be changed by policymakers. However, appropriate institutional settings and regulations determining business conditions can increase economic efficiency, decrease domestic prices of selected products, and thus, increase a country's price competitiveness on international markets. Although general links between business environment and price competitiveness seem to be clear, the impact of various policy measures on producers and market prices needs to be clarified in many cases. This study focuses on the relation between labor market regulations, international competitiveness,[31] and patterns of trade. Specifically, we argue that policy measures which increase labor market flexibility may change the relative price of goods within a country, making it more competitive in international markets for commodities with volatile demand,[32] and, consequently, that flexibility of the labor market can be considered an important factor that would stimulate exports of a broad range of products, especially those with high demand volatility.

Another important theoretical point to be gained from this study is that since an increase in labor market flexibility may change the relative price of goods within the

[31]We refer to the academic definition of international competitiveness which is: "Competitiveness of Nations is a field of Economic theory, which analyzes the facts and policies that shape the ability of a nation to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people" [see International Institute for Management Development (IMD) World Competitiveness Yearbook (WCY): 2003].

[32] The group of products with volatile demand includes seasonal products (e.g., processed meat, fish, fruit, vegetables, and fats), clothes, toys and other items related to, for example, fashionable movies.

country, it can also alter countries' comparative advantage and thus international trade patterns. In particular, we show that due to the differences in relative prices, which result from different labor market regulations, international trade between countries can be observed even if the countries are identical in all respects (e.g., labor productivity, production technology, and consumption preferences). The analysis reveals that a country with a more flexible labor market has comparative advantage in, and tends to export, goods with more variable demand, while a country with a more rigid labor market has comparative advantage in, and tends to export, commodities with more stable demand.

The analysis presented in this paper has been motivated by an observation that within a single industry commodities with relatively stable demand are produced throughout the world, while very similar goods with more volatile demand are produced in particular countries only. One can think about the textile or toy industry where products with relatively stable demand (e.g., traditional clothing) are produced in both developed (with high wages) as well as developing (with low wages) countries, while technologically similar products with more volatile demand (e.g., ethnic-style clothing, toys, cards, CDs, and similar products such as movie tie-ins, for example, Star Wars, Matrix, The Lord of the Rings, and Harry Potter) are produced exclusively in developing countries with very liberal labor market regulations.[33] Another example includes the export of watches and clocks,[34] which have more stable demand on the world markets and are produced throughout the world, versus agricultural goods with high variability such as meat, fish, fruit, vegetables, and fats which have a larger share in the exports of developing countries. This simple example shows that large scale production of goods with volatile demand, and their export to international markets, may significantly

[33]The market for such products is huge. To illustrate the scale, one can consider solely the market for Harry Potter related products, where the total earnings (until the summer of 2003) from the sales of books, movies, video tapes, CDs, video games, and clothes exceeded *3.5* billion USD. In other words, the total earnings from such products exceed the yearly GDP of a number of developing countries (for comparison, the GDP of the Kyrgyz Republic amounted to *1.7* billion USD in 2003). See the International Bank for Reconstruction and Development/the World Bank (IBRD/WB), 2005: World Development Indicators (WDI).

[34]The comparison of export shares (*61* products) across *37* countries based on the standard deviation of each product's sales shows that the watches and clocks group has the lowest variation (*0.001*), while the group of processed meat, fish, fruit, vegetables, and fats has the highest variation of sales (*0.194*) during the period from 1995 to 2002.

improve countries' balance of payments and could have a positive impact on the economy as a whole.

The paper is organized as follows. Section 2 highlights the concept of labor market flexibility. Section 3 focuses on the speed of labor market adjustment to new market conditions. An autarky regime in a simple Ricardian setting under price uncertainty is analyzed in section 4. Section 5 explores the impact of labor market flexibility on international trade. In section 6 key theoretical results are confronted with empirical data and section 7 concludes.

2. The concept of labor market flexibility

The concept of labor market flexibility refers to various phenomena and can be defined by at least three of the following important dimensions (Hamermesh 1996; Pissarides 1997). First, it is related to organizational and productive aspects at the company level, namely, to the ability of a firm to vary its production volume and to introduce new models and products. Second, it refers to the capacity and skills of employees (e.g., building multiple skills, training workers for different production operations, and tasks). Third, it is applied to employment policies, wage adjustments, changes in work schedules, and hiring and firing procedures consistent with production needs.[35] Labor market flexibility is also related to the population aging phenomenon since old workers are generally less mobile and incur high costs resulting from firms' adjustment to demand shocks (Kuhn 2003).

Although labor market flexibility can be related to several phenomena, it can be characterized by the speed of adjustment in response to various shocks in an economy (Pissarides 1997). The virtue of the latter is that one labor market is more flexible than the other one if it adjusts to a given shock faster. In a perfectly flexible labor market, workers are free to allocate their services in response to shifting relative wage opportunities, while firms are free to adjust the workforce in response to shifting relative profit opportunities. Moreover, it is assumed that both workers and firms adapt immediately to any changes in market conditions and in labor demand.[36]

[35] These include, for example, contracts for certain tasks, part-time work or at-home work.
[36] Departing from a neoclassical model (perfectly flexible labor market), decreasing labor market flexibility leads to the other theoretical extreme: the Keynesian concept of rigid labor market (rigid real wages).

In real life, however, there are several constraints that limit the ability of firms and workers to quickly adjust to changing market conditions and labor demand. Employment protection is one of them. It refers to hiring and firing practices on unfair dismissals, lay-off restrictions, severance payments, minimum notice periods, and security against job dismissals. Employment protection can originate from various institutional arrangements. When labor markets are not regulated, employment protection is based on wage compensation schemes and collective bargaining. Namely, firms with high dismissal rates pay workers a compensating wage for occupational hazards. This fact causes firms to implement either an adjustment strategy, through retraining workers and marginal regulations (e.g., attrition, early retirement, work sharing, and severance payments), or firing workers and accepting higher compensating wages. The problems of permanent lay-offs are dealt by unions which represent a collective bargaining mechanism for protecting work places. However, when markets fail (e.g., externalities, imperfect competition, insufficient information, and public goods), the wage compensation mechanism and collective bargaining do not work. In this case governments legislate employment protection through imposing restrictions of different kinds. According to the World Bank (WB), the constraints of labor market flexibility can be ordered from the most (1) to the least (5) severe: 1) hiring difficulties; 2) hours rigidities; 3) firing difficulties; 4) employment rigidities; and 5) firing costs.[37]

Three basic types of employment protection measures are distinguished in the literature (Bertola, Boeri, Cazes 1999; Boeri, Nicoletti, Scarpetta 2000; Hamermesh 1996). The first type includes provisions affecting fixed costs per worker (e.g., the statutory guarantees of payments to workers, various agreements to limit overtime or provide shorter working time). The second type includes provisions that affect the cost of labor adjustment (e.g., redundancy payments, subsidies to retain employees and provisions for unfair dismissals).[38] The third type consists of provisions affecting the process of labor adjustment such as lay-offs by inverse seniority, restrictions on hiring, and various pre-notifications regarding factory closings or redundancies.

[37]See the International Bank for Reconstruction and Development/the World Bank (IBRD/WB), 2005: Doing business in 2005.

[38]Statutory rights against unfair dismissals exist in all countries except the United States (see Bertola, Boeri, and Cazes 1999).

No matter what the type of employment protection and which institutional measures it originates from, any kind of employment protection arrangements, enforcing hiring and firing rules, unemployment benefits, and minimum wages are regarded as factors decreasing labor market flexibility. These factors constrain the free choice of workers and firms and increase the inertia of the labor market (i.e., reduce the speed of labor adjustment to new market conditions). Not going into the details of labor market regulations, in this paper, following Pissarides (1997), we assume that one labor market is more flexible than the other one if firms can faster adjust employment to the new market conditions.

3. The speed of labor market adjustment and a firm's input-output decisions

As discussed in the preceding section, we assume that if the labor market is perfectly flexible, firms are able to adjust the amount of labor needed in the production process to observed market conditions immediately. Any decrease in labor market flexibility makes the adjustments of labor input slower, i.e., increases labor market inertia. Since labor market regulations are usually the same for all sectors in the economy, in the deterministic case (i.e., when the demand for goods is certain) they should have the same impact on all industries. Therefore, labor market regulations would not affect relative prices, and thus, a country's comparative advantage. Under uncertainty of demand, however, all inputs in the production process which are not perfectly flexible (i.e., cannot be adjusted immediately) need to be chosen before the output is produced and the price of real output is observed. Provided that firms are not risk neutral, but risk-averse,[39] the uncertainty about output price affects the optimal input/output decisions of firms (Leland 1972; Yu and Ingene 1993) and, consequently, the relative prices of goods with different output price variability.

To clarify the relationship between the uncertainty of output price and firms' optimal input/output decisions, consider a single commodity market and assume that the price of the unit of output produced is uncertain and can be represented as the sum of two terms, a fixed term (expected value) and a random term (η_t) at any period of time t (t is an

[39]A similar assumption was made by Sandmo (1971), Leland (1972), Cukrowski and Aksen (2003) and Cukrowski, Fischer and Aksen (2002). As indicated by Leland, risk neutrality is frequently assumed just for the sake of simplicity (see Leland, 1972, for detailed discussion).

integer number such that $-\infty<t<+\infty$). For the sake of simplicity, assume that the random variables (η_t) are identically distributed with zero mean and finite variance (σ_t^2). Assume, moreover, that the random deviations from the mean price (η_t) are described by a stationary stochastic process with a memory (e.g., by the auto-regressive processes of any order). This means that the variance and covariance of random variables (η_t) are invariant with respect to displacement in time (i.e., $Var(\eta_t)=Var(\eta)=\sigma^2>0$, $Cov(\eta_t, \eta_{t+s})\neq 0$ for $s=0,1,...,$ and integer valued t ($-\infty<t<+\infty$), and that firms can observe real values of η_t at each period).

Since various labor market regulations, which result in a different degree of labor market flexibility, affect the speed of labor adjustment to changing market conditions, they also determine the time interval needed for labor input fine-tuning. In other words, the degree of labor market flexibility determines the time length between the moment when a firm's decision on its input/output plan is enacted and the moment when its output is supplied to the market and real output price is observed. Note that if the labor market is not perfectly flexible, the firm's input/output decision needs to be made *before* the real demand is known (based on forecasts). Consequently, in the moment of decision making perceived market price variability is inversely related to the flexibility of the labor market. This is because the forecast error of deviation from an expected demand equals zero and its variance increases with the time elapsed from observations to the moment when real output price is revealed (Pindyck and Rubinfeld 1991). For example, if random deviations follow the first-order autoregressive process [e.g., $\eta_t=\phi_1\eta_{t-1}+\varepsilon_t$, where ϕ_1 is a constant parameter and ε_t is a random disturbance term with zero mean and variance σ_ε^2 under the normal distribution $N(0, \sigma_\varepsilon^2)$], the s period forecast estimated in period T, $\eta_t^f(s)$, is $\eta_t^f(s)=\phi_1^s\eta_T$. The forecast error of s periods ahead, $e_T(s)$, is given as $e_T(s)=\varepsilon_{T+s}+\phi_1\varepsilon_{T+s-1}+\ldots+\phi_1^{s-1}\varepsilon_{T+1}$, and it has a variance $E[e_T(s)^2]=(1+\phi_1^2+\phi_1^4+...+\phi_1^{2s-2})\sigma_\varepsilon^2$, which increases (nonlinearly) as s becomes larger (Figure 1).

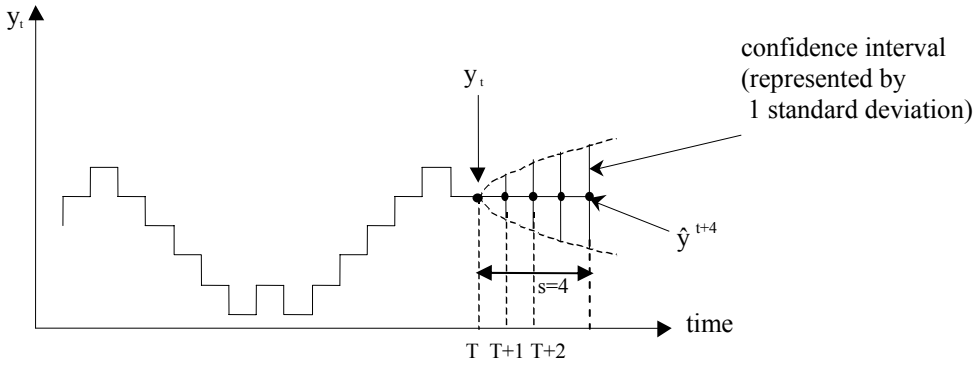


Figure 1. Forecast errors in a first-order autoregressive process

4. Price uncertainty and an autarky regime in a Ricardian setting

For the sake of simplicity the analysis which follows is based on the international trade model in a simple Ricardian setting. The original model is extended by assuming that demand for one good (out of two goods considered) is uncertain. More precisely, two goods, *X* and *Y*, are produced in a perfectly competitive environment, but there is always uncertainty about the price of the first good (*X)*. The technology is summarized by the productivity of labor, which is expressed in terms of the unit labor requirement (i.e., the number of hours required to produce one unit of each good) in each industry. For future reference let us define a_{LX} and a_{LY} as the unit labor requirements in the production of *X* and *Y* goods, respectively. The limits of production in this economy can be determined by the inequality

(1) $$a_{LX}Q_X+a_{LY}Q_Y \leq L,$$

where

(2) $$Q_X=L_X/a_{LX}\text{ , and}$$

(3) $$Q_Y=L_Y/a_{LY},$$

denote, respectively, the quantities of goods *X* and *Y* produced in the economy; L_X and L_Y describe the amount of labor employed in the sectors *X* and *Y*, correspondingly; *L* is the total labor supply.

To determine what the economy will actually produce, one needs to know the expected relative price of goods. The price of good *X* is random and can be represented

as $p_X(\theta)$, where θ is a stochastic parameter that characterizes the state of the world, such that

(4) $$E[p_X(\theta)] = \bar{p}_X,$$

where $\bar{p}_X$ is the expected price of the commodity *X*. Thus, the supply of good *X* in the competitive economy is determined by the attempts of firms to maximize their expected utilities from profits. All firms are assumed to be managed by risk-averse managers[40] and, therefore, their attitudes towards risk can be characterized in a von Neumann-Morgenstern fashion in the form of a utility function (Sandmo 1971; Leland 1972). Risk aversion implies that utility function *U* of profit π is strictly concave: $U'(\pi)>0$ and $U''(\pi)<0$. Thus, each firm operating in industry *X* selects the quantity of output q_x to maximize the expected utility from profit

(5) $$\underset{q_x}{Max}\, E\{U[\pi(q_x)]\}.$$

The first order condition (*FOC*) in a perfectly competitive environment can be represented as

(6) $$E\{U'(\pi_X)[\, p_X(\theta) - wa_{LX}]\} = 0\,,$$

where

(7) $$\pi_X = [p_X(\theta) - wa_{LX}]q_x,$$

and q_X denotes output of a single firm and *w* stands for wage in the economy.

The second order condition (SOC) is

(8) $$D = E[U''(\pi_X)(p_X(\theta) - wa_{LX})^2] < 0\,.$$

Rearranging FOC we get

(9) $$wa_{LX} = \frac{E[U'(\pi_X)p_X(\theta)]}{E[U'(\pi_X)]}.$$

Expression *(9)* allows us to prove the following important proposition:

Proposition 1. *Under uncertainty, perfectly competitive firms equate marginal cost to a certain value bigger than the price under certainty ($\bar{p}_X$), i.e.,*

(10) $$\frac{E[U'(\pi_X)p_X(\theta)]}{E[U'(\pi_X)]} > \bar{p}_X\,.$$

[40] See Mayer (1978) and Batra (1974).

Proof:

Let $U'(\bar{\pi}_X)$ be the marginal utility of profit for $\theta = \bar{\theta}$, such that $p_X(\bar{\theta}) - \bar{p}_X = 0$. Since the marginal utility is decreasing and all profits are non-negatively correlated, we must have that $U'(\pi_X) \le U'(\bar{\pi}_X)$ for θ, such that $p_X(\theta) - \bar{p}_X \ge 0$. Multiplying both sides of the inequality above by $p_X(\theta) - \bar{p}_X$, we get

(11) $$U'(\pi_X)(p_X(\theta) - \bar{p}_X) \le U'(\bar{\pi}_X)(p_X(\theta) - \bar{p}_X).$$

If $p_X(\theta) - \bar{p}_X \le 0$, then $U'(\pi_X) \ge U'(\bar{\pi}_X)$, and consequently the sign in the last inequality is unaffected. Taking expectation we have

(12) $$E[U'(\pi_X)(p_X(\theta) - \bar{p}_X)] \le U'(\bar{\pi}_X)E[(p_X(\theta) - \bar{p}_X)] = 0,$$

and taking into account that

(13) $$E[U'(\pi_X)(p_X(\theta) - \bar{p}_X)] = E[U'(\pi_X)(p_X(\theta)] - E[U'(\pi_X)]\bar{p}_X \le 0,$$

we get

(14) $$E[U'(\pi_X)p_X(\theta)] / E[U'(\pi_X)] \ge \bar{p}_X.$$

Q.E.D

An important implication of *Proposition 1* is that the total output of industry *X* under uncertainty is smaller than it would be under certainty.

Perfect competition in industry *Y* (without uncertainty) implies that the price of the good *Y*, $\bar{p}_Y$, equals marginal cost:

(15) $$w = \bar{p}_Y / a_{LY}.$$

Since wage rates need to be equal across sectors, we have

(16) $$E[p_X]/\bar{p}_Y = E[p_X/\bar{p}_Y] \ge \bar{p}_X/\bar{p}_Y = a_{LX}/a_{LY}.$$

It follows from the expression *(16)* that in industry *X* the expected relative price of goods *X* and *Y* under uncertainty will be higher than in the certainty case.

The proposition below reveals a link between the magnitude of price fluctuations and the expected relative price of the goods *X* and *Y*.[41]

[41] The analysis presented in this paper can be replicated in a more general and more complex setting with two sectors and two production factors (as in the Heckscher-Ohlin model of international trade), but the complexity of the model makes it hardly readable. As an example, a link between labor market flexibility, expected relative prices within the country, and country price competitiveness in international markets in the model with two sectors and two production factors is analysed in the appendix.

Proposition 2. *An increase in the price variability of good X with uncertain demand decreases the amount of labor allocated to the production of commodity X and increases the expected relative price of goods X and Y.*

Proof.

Consider the effect of a marginal increase in uncertainty on the demand for labor input. To present the notion of increased uncertainty, define an increased variability in the density function of the price of good X in terms of a "mean preserving spread,"[42] i.e., define random variable p_X^* as

(17) $$p_X^* = \gamma p_X + \varpi ,$$

where p_X^* is a random price, ϖ and γ are shift parameters which initially equal zero and unity, respectively. The mean preserving spread type of the shift in the density function of p_X^* leaves mean $E[p_X^*]$ unchanged, that is

(18) $$dE[p_X^*] = dE[\gamma p_X + \varpi] = \bar{p}_X d\gamma + d\varpi = 0 .$$

Substituting p_X^* by p_X in the FOC of sector *X*, we obtain

(19) $$E[U'(\pi_X)(\gamma p_X + \varpi - wa_{LX})] = 0,$$

where

(20) $$\pi_X = [(\gamma p_X + \varpi) - wa_{LX}]q_x .$$

Differentiating *(20)* with respect to γ and taking into account that $d\varpi/d\gamma = -\bar{p}_X$ we get

(21) $$\frac{dq_X}{d\gamma} = -q_X \frac{1}{D} E[U''(\pi_X)(p_X - \bar{p}_X)(p_X - wa_{LX})] - \frac{1}{D} E[U'(\pi_X)(p_X - \bar{p}_X)],$$

where *D* is the SOC determined by expression *(8)*.

The second term in expression *(21)* is negative and the first term is generally indeterminate.[43] However, in the particular case when we assume that the initial situation is such that $p_X = \bar{p}_X$ and an increased uncertainty causes only a very small increase in risk, then a certain price can be replaced by the probability distribution with all outcomes

[42] Defining a change in uncertainty in terms of a change in the probability distribution, while keeping its mean constant, is quite common in economic theory (see, for example, in Sandmo (1971), Rothenberg and Smith (1971), and Rothschild and Stiglitz (1970, 1971).

[43] At this level of formalization, making a clear statement on the marginal effect of uncertainty on output is unlikely. To deal with this difficulty, one can focus on a particular case when the marginal impact of uncertainty is identical to its overall impact, i.e., when increased uncertatinty leads to just a little more risky distribuition than the initial one (see Sandmo 1971).

concentrated in the neighborhood of $\overline{p}_X$. And, if price is known to be equal to $\overline{p}_X$, the marginal cost is also equal to $\overline{p}_X$. So, we must have

$$\overline{p}_X = wa_{LX}, \text{ and}$$

$$(22)\quad \frac{dq_X}{d\gamma} = -q_X \frac{1}{D} E[U''(\pi_X)(p_X - \overline{p}_X)(p_X - \overline{p}_X)] - \frac{1}{D} E[U'(\pi_X)(p_X - \overline{p}_X)].$$

$$(23)\quad -q_X \frac{1}{D} E[U''(\pi_X)(p_X - \overline{p}_X)^2] < 0.$$

Therefore, if the distribution of prices is concentrated around its mean value $dq_X / d\gamma < 0$, an increase in price volatility decreases the quantity of output produced and increases the expected price of good *X*.[44] Taking into account that the price of good *Y* is deterministic, we conclude that an increase in the price variability of good *X* has two effects. First, since the quantity of output produced is proportional to the quantity of labor used, it decreases the amount of labor allocated to the production of commodity *X*. Second, it increases the expected relative price of goods *X* and *Y*.

Q.E.D.

One implication of Proposition 2 is that higher labor market flexibility resulting in a smaller time lag between the moment at which decision-making concerning labor is made and the moment at which the price of an output becomes known decreases the price of the good with uncertain demand, and thus makes the country more competitive in the international market for this commodity. This important result can be formulated as the following corollary:

Corollary 1. *An increase in labor market flexibility makes a country more competitive in international markets for commodities with uncertain demand.*

Proof.

As it is mentioned in section 3, lower market flexibility implies a slower adjustment of labor input to market conditions, and thus increases the time period between the moment when the firm's input/output decision needs to be made and the

[44] This result is consistent with Sandmo (1971) among others. We need to mention that Batra and Ullah (1974) show that in any case an increase in uncertainty leads to a decline in the firm's output if absolute risk aversion is decreasing.

moment when the output is supplied to the market and real output price is observed (see Figure 1). This in turn implies that if labor market flexibility decreases, the uncertainty about demand at the moment of decision making (and price variability) increases (and vice versa). Consequently, by *Proposition 2*, an increase in labor market flexibility decreases the expected relative prices of goods with uncertain demand with respect to ones with certain demand. In other words, higher labor market flexibility leads to the reduction of absolute prices of goods with uncertain demand, and, therefore, makes a country more competitive in international markets for the commodities with uncertain demand.

Q.E.D.

The other important implication of *Proposition 2* is that differences in labor market flexibility, determining a time lag between the time when a decision concerning labor is made and the time when prices for output became known, and thus price variability in the time of decision making, lead to different expected relative prices, and, consequently, may change patterns of trade or cause international exchange of goods.

5. The impact of labor market flexibility on international trade patterns

Consider a world of two countries, *A* and *B*, and assume that each of the two countries has only one scarce factor of production (labor), and can produce two goods, *X* and *Y*. Production technologies are described by unit labor requirements a_{Li}^{J}, where $J \in \{A, B\}$ and $i \in \{X,Y\}$. Assume that the unit price of commodity *Y* is deterministic and the unit price of commodity *X* is uncertain. Suppose also that the labor market in country *A* is more flexible than in country *B*, which implies that input/output decisions in sector *X* in country *B* have to be made earlier than in country *A*, and, consequently, that deviation of expected relative prices from relative prices in the deterministic case in country *B* is always greater than in country *A*. This may change the pattern of trade predicted by the classical Ricardian model in the way described by one of the propositions below.

Proposition 3. *Two countries, identical with respect to production technology and labor productivity, can be involved in international trade: the country with a*

more flexible labor market will tend to export goods with uncertain demand, while the country with a more rigid labor market will tend to export goods with deterministic demand.

Proof.

Lack of differences in production technology and labor productivity imply that

(24) $$a_{LX}^{A}/a_{LY}^{A}=a_{LX}^{B}/a_{LY}^{B},$$

i.e., in the deterministic case no country has a comparative advantage, and therefore international exchange of goods is not observed. *Proposition 2* implies that under uncertainty higher labor market flexibility in country *A* will result in smaller expected relative prices in country *A* than expected relative prices in country *B*, and, consequently, country *A* will tend to export good *X* (with uncertain demand) while country *B* will tend to export good *Y* (with deterministic demand).

Q.E.D.

The *Proposition 4* implies that a rational for international trade exists even if there is no comparative advantage in the sense of differences among countries in technology and labor efficiency. Under uncertainty, a difference in labor market flexibility is the only reason for comparative advantage and international exchange of goods.

Proposition 4. *Under uncertainty, differences in labor market regulations may change trade patterns resulting from a comparative advantage in labor productivity and production technology.*

Proof.

In the deterministic case, country *B* has a comparative advantage in producing *X* if

(25) $$a_{LX}^{A}/a_{LY}^{A}>a_{LX}^{B}/a_{LY}^{B}\ .$$

Consequently, country *B* has also lower relative prices of goods *X* and *Y*, and thus it exports good *X* in exchange for good *Y*. *Proposition 2* implies that under uncertainty, expected relative prices in country *A* (with a more flexible labor market) may rise less than expected relative prices in country *B* (with a more rigid labor market), and, consequently, country *A* will tend to export good *X* while country *B* will tend to export good *Y*. So, in this case difference in labor market flexibility changes the trade pattern

predicted based on comparative advantage in labor productivity and production technology.

Q.E.D.

An important implication of *Proposition 4* is that in the real world, where input/output decisions concerning production of most goods are made under uncertainty, trade patterns can differ from ones that follow from classical economic theory under certainty.

6. Empirical evidence

This section deals with empirical evidence where the following testable proposition is postulated: *the share of export of the sectors with high variation of firm sales increases with labor market flexibility*. The hypothesis reflects theoretical results formulated as *Proposition 2*, *Corollary 1*, and *Proposition 3*. In particular, a high degree of labor market flexibility allows firms facing demand uncertainty to more quickly adjust their production capacities to shifts in demand. The reallocation of labor across firms within a certain industry is reflected in the change of sales of firms and industry groups as well (see *Proposition 2* and *Corollary 1*). Since in a country with a more flexible labor market the scale of firms' adjustment is much higher (i.e., there are substantial labor and production shifts across industry groups), a country with a more flexible labor market tends to export more goods with variable demand (as indicated in *Proposition 3*). On the contrary, in a country with a more rigid labor market, labor and production shifts across industry groups are much smaller, and therefore, countries with a more rigid labor market tend to export goods with stable demand.

In order to test the hypothesis formulated above, we analyse the impact of labor market regulations on export demand variability within the manufacturing sector. The equation specification is of the following panel regression form:

(26) $$WVAR_{it} = \alpha_1 + \alpha_2 LMF_{it} + u_{it},$$

where LMF_{it} reflects the labor market flexibility index, u_{it} is the error term, and the dependent variable denotes the weighted variances of firms' sales ($WVAR_{it}$), the fraction of an industry's exports with high variation of the firm's sales. It is determined as the

weighted variation of a single firm's sales, which are calculated across years, from the mean variation across all industries, whose export shares are taken as corresponding weights:

$$WVAR_{it} = \left[\sum_{j=1}^{J} w_j \left(VAR_j(q) - \overline{VAR} \right)^2 \right]_{it},$$

s.t. :

$$\sum_{j=1}^{J} w_j = \sum_{j=1}^{J} \frac{ex_j}{EX} = 1, \qquad (27)$$

$$VAR_j(q_{jt}) = \frac{1}{T} \sum_{t=1}^{T} \left(q_{jt} - \frac{1}{T} \sum_{t=1}^{T} q_{jt} \right),$$

$$\overline{VAR} = \frac{1}{J} \sum_{j=1}^{J} VAR_j(q_{jt}),$$

where I is a number of countries, T number of years, and J number of industries; w is the weight or the share of an individual industry's export (ex) in the total exports of all industries (EX); q denotes the average sale of a single firm.

The hypothesis test is H0: $\alpha_2=0$, against H1: $\alpha_2>0$. That is, the fraction of an industry's exports with high variation of firms' sales increases with the degree of labor market flexibility (i.e., α_2 is positive).

By pooling all the available observations that cover data from *37* countries ($I=37$) including the values of exports, the number of establishments, the volume of sales across *61* manufacturing products ($J=61$), and the labor market flexibility indexes for the period 1995 to 2002 ($T=8$),[45] the regression coefficients are estimated by ordinary least squares (OLS), random effect (RE) and fixed effect (FE) models. The data for the export products and the number of establishments come from the United Nations Industrial Development Organization's (UNIDO) *Industrial Statistics Database* and national statistics offices databases at the three digit level of International Standard Industrial Classification (ISIC) of revision 2. As the proxy of labor market flexibility, the employment law indexes, which are presented in *Global Competitiveness Yearbook (GCY)* by the International Institute for Management Development (IMD) are used. Table 2 demonstrates the statistical moments of the main variables included in model estimation.

[45] A comparable data set is not yet available for 2003 and 2004 for all products and countries included in the study.

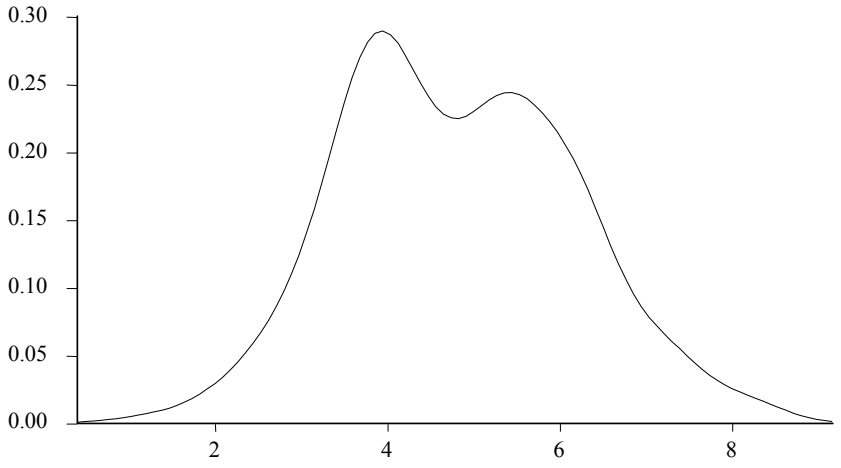
Table 1. Descriptive statistics of the variables used in the model

	Minimum	Maximum	Median	Mean	Std. dev.	Skewness	Kurtosis
LMF	1.1922	8.3612	4.7119	4.8109	1.3337	0.1781	2.6536
VWAR	0.0133	249.9037	6.6709	16.2196	25.5625	4.9215	39.5923

Source: the author's calculations

In terms of statistical descriptors, which are presented in Table 2, the labor market flexibility indexes are characterized by better properties than those of the weighted variances. The labor market flexibility indexes, for example, range from a minimum of *1.1922* to a maximum of *8.3612* with a mean value of *4.8109* and a standard deviation of *1.3337*, indicating that the presence of extreme outliers is not likely in the data. The dependent variable, however, lies in a range from a minimum *0.0133* to a maximum *249.9037* with a mean of *16.2196* and a standard deviation *25.5625*. Hence, in terms of the third and fourth moments, labor market flexibility indexes are better distributed than the weighted variances, as demonstrated in Figure 2.

a)



LMF: Kernel Density (Normal, h = 0.3934)

b)

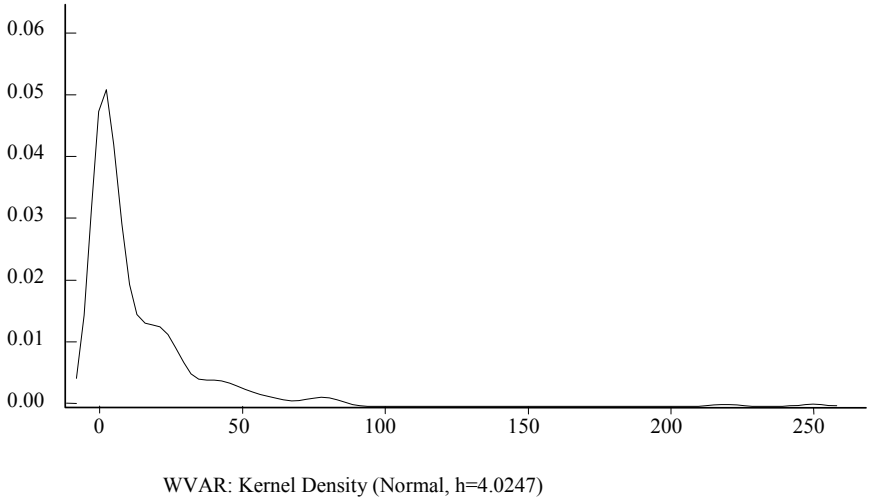


Figure 2. The shapes of distribution: a) *LMF*; b) *WVAR*

It follows from Figure 2 that the shape of the distribution plotted on the labor market flexibility indexes is closer to that of normal distribution, while the distribution of the weighted variations of firms' sales is very leptokurtic with most of the data concentrated within a more narrow range.[46] High kurtosis reflects few large values of the weighted variation of firms' sales (see Figure 3).

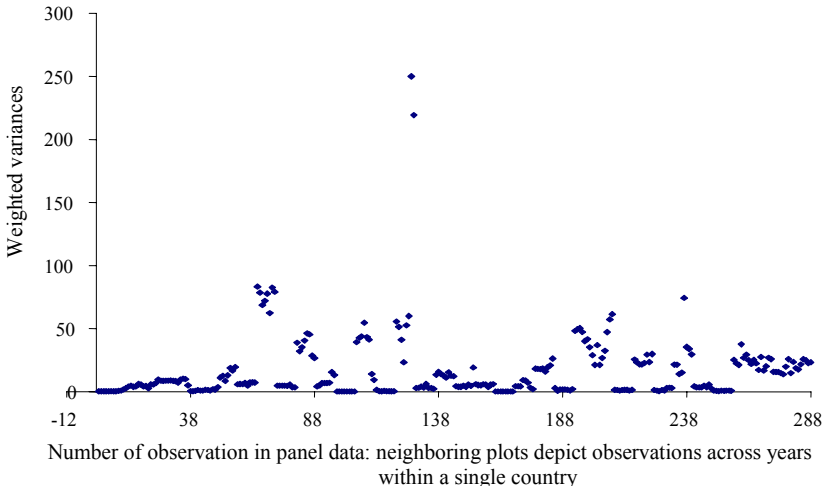


Figure 3. Weighted variances in panel data

[46]Normal distributions are characterized by the kurtosis equal to *3* (see Green 2001).

The comparison of weighted variances across countries identifies Hungary, where the variance increased from *60* to *260* in 2001, as an outlier in the sample data and, thus, it is excluded from the data set. The results of an econometric estimation are demonstrated in Table 3.

Table 2. The estimation parameters of OLS (the panel for *I=36* countries and *T=8* years)

Dependent variable Independent variables	$WVAR_{it}$ C, LMF_{it}	Regression models[I]			
Coefficient estimates		Pooled OLS	Pooled OLS (White-robust SE)	RE-model	FE-model
Constant term	α_1	-10.2650 (4.1128)*	- 10.2650 (3.9729)*	-0.4336 0.7919	-0.2221 (0.3081)
The LMF index	α_2	4.9806 (0.8293)*	4.9806 (0.8850)*	3.3518 (0.7489)*	2.5479 (0.5015)*
R-squared		0.1252	0.1252	0.0949	0.0851
Prob. (F-statistic) of zero slope		0.0000	0.0000	0.0000	0.0000
95% confidence interval of α_2		[3.35, 6.61]	[3.24, 6.72]	[1.88, 4.83]	[1.56, 3.53]
Hausman specification test: FE versus RE $\chi^2(1) = [(\alpha_{2,FE}-\alpha_{2,RE})'[(V\_\alpha_{2,FE} - V\_\alpha_{2,RE})^{(-1)}](\alpha_{2,FE}-\alpha_{2,RE}) = 1.46$ $\chi^2(1)_{critical} = 3.84$				$\chi^2 < \chi^2_{critical}$	

[I]The estimated asymptotic standard errors (SE) are shown in the brackets below the estimated coefficients: (*) indicates a *1%* significance level.

As Table 2 demonstrates, the results of pooled OLS reveal the presence of a positive first-order serial correlation in residuals as presented in Table 3 (the Durbin-Watson statistics is *0.07*).[47] The null hypothesis of homoscedasticity, which is tested by computing White statistics by regressing the squared least squares residuals on a constant, LMF, and LMF^2 ($NRT^2=8.32 \sim \chi^2$) is rejected in favor of the alternative hypothesis of heteroscedasticity.[48] These findings suggest that standard errors and estimated coefficients are not valid to make an inference. Since the residuals are not independent, the RE model is applied, but first, the model with robust estimation is performed and regression models with robust standard errors are applied. The robust *95%* confidence interval is wider than both the

[47] The null hypothesis of no AR(1) serial correlation in OLS residuals is rejected at the *5%* level.
[48] The *5%* critical value from the table for the chi-squared statistics with 2 degrees of freedom is *5.99*.

previously estimated OLS and RE regression results by *0.22* and *0.53*, correspondingly. In order to test the appropriateness of the RE estimator, we estimate the FE-model and perform a Hausman specification test.[49] As reported in Table 3, the reported χ^2 value is smaller than the critical value, so that the *H0* cannot be rejected at the *5%* significance level. This suggests that the RE-model is the preferred option for making an inference.

Based on the results obtained by the RE-model, one can infer that an *1* point higher degree of labor market flexibility corresponds to a *3.35* point larger variation of firm sales weighted by export industry export shares. The estimated R^2 explains about *9.94*% of the variation. The empirical evidence confirms the presence of a significant positive relationship between labor market flexibility and the export shares of sectors with high variation of firms' sales. This can imply that firms respond to demand fluctuations by reallocating inputs to the production of goods with higher world demand which causes an increase in the variation of sales across firms as well as industry groups. As a result, a country with more flexible labor market is more competitive in goods with flexible demand and exports more goods with higher variation of sales due to the fact that the scale of firms' adjustment is much higher and there are substantial labor and production shifts across industry groups. On the contrary, in a country with a more rigid labor market, the variation of exports across industry groups is smaller due to lower adjustment speed. Therefore, countries with a more rigid labor market tend to export goods with more stable demand.

7. Conclusion

The analysis above explored the links between labor market regulations and prices of commodities with uncertain demand, relative prices within the country and patterns of trade. It has been shown that since flexible labor market regulations allow companies to adapt to changes in demand quickly, firms' decisions regarding labor input may be made based on better predictions (i.e., under smaller uncertainty), which improves economic efficiency leading to better allocation of resources. This in turn leads to lower prices of the commodities with uncertain demand within countries and makes

[49]The hypothesis test is that the individual country-specific effects are uncorrelated with the other repressors in the model.

them more competitive on international markets for these products. Since in the real world, suppliers of most commodities and services face uncertain demand, a high degree of labor market flexibility may significantly increase competitiveness of all countries including those with high wage levels. On the contrary, rigid labor market regulations may increase prices for most goods and services within countries and thus decrease competitiveness of these countries, even those with relatively low wages.

These theoretical results have been confronted with empirical evidence and a positive correlation between labor market flexibility and export variation across product groups has been confirmed. This implies that in response to world demand shifts, countries with flexible labor markets can reallocate labor across industry groups towards production of goods with higher demand. This causes an increase in the variation of sales across firms and industry groups as well. As a result, countries with more flexible labor markets export more goods with higher variation of sales due to the fact that the scale of firms' adjustment is much higher. On the contrary, in countries with more rigid labor markets, the variation of exports across industry groups is smaller due to lower adjustment speed, and the exports of goods with more stable demand is larger. The link between labor market flexibility and relative prices of goods in autarky explored in the paper reveals also that there would be a justification for international trade between identical countries even if markets are perfectly competitive. International exchange of goods with different price variability may stem from differences in labor market institutional settings. Simple analysis of possible trade patterns in a modified Ricardian setting shows that even if countries are similar in all respects (e.g., labor productivity or technology), but have differences in labor market regulations, then international trade among these countries can be observed, and a country with a flexible labor market will tend to export goods with variable demand, while a country with a rigid labor market will tend to export goods with stable demand.

Since an increase in labor market flexibility has a positive impact on countries' international competitiveness and thus on their balance of trade, a number of actions which may help liberalize labor markets can be recommended to both developed and developing counties. Generally, measures for increasing labor market flexibility require policy actions on several different levels. Firstly, removing the sources of labor market

rigidities through institutional arrangements and changes in labor legislation at the macro level is widely recommended. The policy actions at this level involve measures for reducing the power of unions, the role of collective bargaining, and the level of employment protection. From the perspective of labor market flexibility at the intra-enterprise level, regulations can be accomplished through increasing wage and working hours flexibility, eliminating incentives for wage arrears, restructuring social assets, and using such active adjustment mechanisms as training and retraining policies. Such measures ease the movement of workers from one job to another and lower the cost of dismissals by inducing employers to fire workers with obsolete skills and hire new workers. It needs to be emphasized, however, that policy actions in a concrete country or region should be designed taking into account the specific environment, including macroeconomic conditions, the level of market development, value system, cultural heritage and many other factors.

There are many ways in which this study can be extended and generalized. In particular, the problem considered in the paper can be presented in a broader framework using a standard two countries, two commodities and two production-factors model (Heckscher-Ohlin model). Such an analysis, although quite complicated (see Appendix), can lead to a number of interesting conclusions regarding, e.g., the impact of labor market regulations on relative prices of labor and capital intensive commodities with different demand uncertainty, predictions of the Heckscher-Ohlin theorem and the Rybczynski theorem, as well as on the distribution of welfare within trading countries, and thus on poverty reduction.

Appendix

Labor market flexibility and relative prices of goods in a two factors and two sectors model under uncertainty

Consider a single economy with two perfectly competitive sectors, one of them producing a commodity *X* and the second one – a commodity *Y*. There are two factors of production: capital *(K)* and labor *(L)* available in fixed supply. Assume that production technology in the sectors *X* and *Y* can be characterized by Cobb-Douglass production functions f_X and f_Y: $f_X(K_X,L_X)= L_X^{\alpha} K_X^{1-\alpha}$ $(0<\alpha<1)$ and $f_Y(K_Y,L_Y)= L_Y^{\beta} K_Y^{1-\beta}$ $(0<\beta<1)$, where L_X, K_X and L_Y, K_Y are the amounts of labor and capital employed in the industries *X* and *Y*, respectively. Following the analysis presented in Section 4, all firms are assumed to be managed by risk-averse managers and, therefore, their attitudes towards risk can be characterized in a von Neumann-Morgenstern fashion in the form of a utility function [risk aversion implies that utility function *U* of profit π is strictly concave: $U'(\pi)>0$ and $U''(\pi)<0$]. Consumption patterns can be derived from the following utility functions $U(Q_X, Q_Y) = Q_X^{\sigma} Q_Y^{1-\sigma}$ $(0<\sigma<1)$, where Q_X, Q_Y denote the quantities of goods *X* and *Y* consumed, respectively; but in the analysis which follows we assume that the demand of commodity *X* is always uncertain, while the demand of commodity *Y* is known for sure at any moment of time.

In order to simplify the analysis, following the considerations presented in Section 3, assume that an error term in the prediction of price is a normally distributed random variable with zero mean and variance σ_t^2 (this corresponds to the case when random deviations follow stochastic processes with normally distributed random terms such as, for example, the autoregressive process of any order).[50] Since the distribution of the total random deviation from the mean value of price is normal, the total deviation can take a positive or a negative value, each having probability ½. Namely, the expected values of a

[50] It should be stressed that although the assumption of the normal distribution of the random deviations from the expected price corresponds to the wide class of stochastic processes that would govern stochastic price movement, it is chosen solely for simplicity and clarity, and no attempt is made at generality. We believe, however, that many of the qualitative results would hold also in more general, and, consequently, more complicated models.

positive and a negative value equal $\sigma_t/\sqrt{2\pi}$ and $-\sigma_t/\sqrt{2\pi}$, correspondingly.[51] Consequently, the price of commodity *X* at any time *t (*such that -∞<*t*<+∞*)* can be approximated as $P_x + \vartheta(\sigma_t)$, where $\vartheta(\sigma_t)$ is a random factor (not known ex-ante) that equals $\theta(\sigma_t)$ with probability ½ and -$\theta(\sigma_t)$ with probability ½, respectively [$\theta(\sigma_t) = \sigma_t/\sqrt{2\pi}$]. So, the price of commodity X is presented as $P_x - \theta(\sigma_t)$ with probability ½ and $\overline{P} + \theta(\sigma_t)$ with probability ½. In such a framework we can prove the following proposition:

Proposition A1. *An increase in labor market flexibility decreases the expected relative price of goods X with respect to good Y and makes the country more competitive in international markets for a commodity with uncertain demand.*

Proof.

Perfect competition implies that the profits of all firms operating in industry *Y* (with certain demand) equal zero. The cost function of firms operating in industry Y is described as

$$C(Y) = a_{KY} r + a_{LY} w. \qquad (A.1)$$

The terms *r* and *w* in the expression (*A.1*) denote the price of capital and labor, and $a_{K,Y}$ and $a_{L,Y}$ are the amounts of capital and labor needed to produce one unit of commodity *Y*, respectively.

To allocate resources, the firms operating in sector *Y* solve the following optimization problem:

$$\underset{a_{KY}, a_{LY}}{Min} (a_{KY} r + a_{LY} w), \text{ s.t. } {a_{KY}}^{\beta} {a_{LY}}^{1-\beta} = 1.$$

The *Lagrangian* for this optimization problem can be represented as

---

[51] Expected values of positive and negative deviations are computed as $\int_0^{\infty} \frac{\tilde{\eta}_t}{\sqrt{2\pi{\sigma_t}^2}} e^{\frac{-\tilde{\eta}_t^2}{2{\sigma_t}^2}} d\tilde{\eta}$ and $\int_{-\infty}^{0} \frac{\tilde{\eta}_t}{\sqrt{2\pi{\sigma_t}^2}} e^{\frac{-\tilde{\eta}_t^2}{2{\sigma_z}^2}} d\tilde{\eta}_t$, respectively ($\tilde{\eta}_t$ prediction error equals).

$$\mathsf{L} = a_{KY} r + a_{LY} w - \xi(a_{KY}{}^{\beta} a_{LY}{}^{1-\beta} - 1),$$

and FOC[52] imply that

$$\frac{r}{w} = \frac{\beta}{1-\beta}\frac{a_{LY}}{a_{KY}}. \qquad (A.2)$$

In industry *X* (facing uncertain demand), the firms behave purely competitively, know their cost functions with certainty, and maximize expected utility from profit. The Cobb-Douglas production function implies that there is perfect substitution between production factors, so that firms can optimally adjust their input combination in response to changes in demand conditions. The crucial assumption is that labor is completely variable, whereas capital is quasi-fixed. In the consideration below this is taken into account by assuming that capital input is chosen *ex-ante* (i.e., before actual demand is observed),[53] whereas demand for labor takes place *ex-post* (i.e., after choice of capital, however, if the labor market is not perfectly flexible also before an actual demand is observed). Therefore, the firm's input decisions are distributed in time as presented in Figure A1 and, consequently, both decisions are taken under uncertainty of demand. Decisions regarding the amount of capital are made at time T_1 [facing price fluctuations $\gamma(\sigma_{T_1})$], while decisions regarding the amount of labor are made at time T_2 [facing price fluctuations $\lambda(\sigma_{T_2})$]. So, as $T_1 \leq T_2$, we have $\sigma_{T_1} > \sigma_{T2}$ and $\gamma(\sigma_{T_1}) > \lambda(\sigma_{T_2})$. In order to simplify notations in the analysis which follows, we will refer to price fluctuations in the moments of time T_1 and T_2 as to γ and λ, respectively.

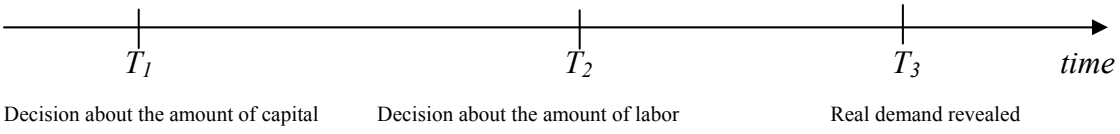


Figure A.1. Timing of a firm's input decisions in industry *X*

[52] The Hessian of the Lagrangian is positive semi definite and thus the second order conditions to this optimization problem hold.

[53] Capital expenditures should be understood as irreversible investments costs required to purchase and tune machines, design and prepare specific moulds and tools.

Under uncertainty, the firms maximize expected utility from profit. To simplify the analysis assume that the exact shape of the utility function U is specified as follows:[54]

$$U(\pi) = \begin{cases} a\pi, & if \quad \pi < \Pi_z^0, \\ b\pi_z + (a-b)\pi^0, & if \quad \pi \geq \Pi^0, \end{cases}$$

where $a > b > 0$ *and* $\underline{\pi} < \Pi^0 < \bar{\pi}$.[55]

Thus, for any given amount of capital selected in time T_1, firms set the amount of labor (in time T_2) considering the following optimization problem (production function implies labor demand function is $l_X = q_x^{\frac{1}{\alpha}} k_X^{\frac{\alpha-1}{\alpha}}$, where q_x denotes the output of a single firm):

$$\underset{q_x}{Max}\{\frac{1}{2}a[(P_X - \lambda)q_X - rk_X - wq_x^{\frac{1}{\alpha}} k_X^{\frac{\alpha-1}{\alpha}}] + \frac{1}{2}b[(P_X + \lambda)q_X - rk_X - wq_x^{\frac{1}{\alpha}} k_X^{\frac{\alpha-1}{\alpha}}].$$

From FOC [56]

$$\frac{1}{2}a[(P_X - \lambda) - \frac{1}{\alpha} wq_x^{\frac{1}{\alpha}-1} k_X^{\frac{\alpha-1}{\alpha}}] + \frac{1}{2}b[(P_X + \lambda) - \frac{1}{\alpha} wq_x^{(\frac{1}{\alpha}-1)} k_X^{\frac{\alpha-1}{\alpha}}] = 0$$

(setting $\phi = (b-a)/(a+b) < 0$), we get

$$P_X = \frac{1}{\alpha} w\left(\frac{k_X}{q_X}\right)^{\frac{\alpha-1}{\alpha}} - \phi\lambda ,$$

and finally

$$P_X = \frac{1}{\alpha} wa_{KX}^{\frac{\alpha-1}{\alpha}} - \phi\lambda \qquad (A.3)$$

where $a_{K,X}$ denotes the amount of capital needed to produce one unit of commodity X.

In time T_1, firms facing demand fluctuations γ ($\gamma \geq 0$) take the price of the commodity as given and set their output assuming that the amount of labor will be determined in time T_2 (facing demand fluctuations λ, $\gamma \geq \lambda \geq 0$). So, output is set as a function of labor, considering the following optimization problem (the production function implies the capital demand function is $k_X = q_x^{\frac{1}{1-\alpha}} l_X^{\frac{\alpha}{\alpha-1}}$):

---

[54] See Cukrowski, Fischer and Aksen (2002).

[55] Note that for $a > b > 0$ the function defined is concave and twice differentiable if $\pi \in (-\infty, \infty) \setminus \Pi_z^0$.

[56] Since $\frac{\partial^2 E[U(\pi)]}{\partial q_x^2} = -\underbrace{\frac{(1-\alpha)}{2\alpha^2}}_{>0} wk^{(1-\frac{1}{\alpha})} q^{(\frac{1}{\alpha}-2)}(a+b) < 0$, the SOC holds.

$$\underset{q_X}{Max}\{\frac{1}{2}a[(P_X-\gamma)q_X - rq_x^{\frac{1}{1-\alpha}}l_X^{\frac{\alpha}{\alpha-1}} - wl] + \frac{1}{2}b[(P_X+\gamma)q_X - rq_x^{\frac{1}{1-\alpha}}l_X^{\frac{\alpha}{\alpha-1}} - wl]\},$$

FOC; [57]

$$\frac{1}{2}a[(P_X-\gamma) - \frac{1}{1-\alpha}rq_x^{(\frac{1}{1-\alpha}-1)}l_X^{\frac{\alpha}{\alpha-1}}] + \frac{1}{2}b[(P_X+\gamma) - \frac{1}{1-\alpha}rq_x^{(\frac{1}{1-\alpha}-1)}l_X^{\frac{\alpha}{\alpha-1}}] = 0$$

implies that

$$P_X = \frac{1}{1-\alpha}ra_{LX}^{\frac{\alpha}{\alpha-1}} - \phi\gamma, \qquad (*)$$

where $a_{L,X}$ denotes amount of labor needed to produce one unit of commodity *X*.

From *(*)* and *(A.3)* it follows that $\frac{1}{1-\alpha}ra_{LX}^{\frac{\alpha}{\alpha-1}} - \phi\gamma = \frac{1}{\alpha}wa_{KX}^{\frac{\alpha-1}{\alpha}} - \phi\lambda$, and after rearrangement it gives

$$\frac{\alpha}{1-\alpha}ra_{LX}^{\frac{\alpha}{\alpha-1}} - wa_{KX}^{\frac{\alpha-1}{\alpha}} = \alpha\phi(\gamma-\lambda). \qquad (A.4)$$

Homogeneity of degree one of the production functions [$f_X(K_X,L_X) = L_X^{\alpha}K_X^{1-\alpha}$, $(0<\alpha<1)$ and $f_Y(K_Y,L_Y) = L_Y^{\beta}K_Y^{1-\beta}$ $(0<\beta<1)$] implies that

$$a_{LY}^{\beta}a_{KY}^{1-\beta} = 1 \qquad (A.5)$$

and

$$a_{LX}^{\alpha}a_{KX}^{1-\alpha} = 1. \qquad (A.6)$$

Full resource utilization implies that

$$Q_Y a_{LY} + Q_X a_{LX} = L \qquad (A.7)$$

and

$$Q_Y a_{KY} + QXa_{KX} = K. \qquad (A.8)$$

The relative demand function for goods *X* and *Y* can be derived (in the moment T_3) from the maximization of consumers' utility function under the budget constraints

$$\underset{Q_X,Q_Y}{Max}\, Q_Y^{\sigma}Q_X^{1-\sigma}, \quad \text{s. t. } P_YQ_Y + P_XQ_X \le M,$$

[57] Since $\frac{\partial^2 E[U(\pi)]}{\partial q_X^2} = -\underbrace{\frac{\alpha}{2(1-\alpha)^2}(a+b)}_{>0}rl^{(\frac{\alpha}{\alpha-1})}q^{(\frac{2\alpha-1}{1-\alpha})} < 0$, the SOC holds.

where P_Y, P_X denote, respectively, the prices of good Y and X, and M is consumer's budget. The *Lagrangian* for this problem can be represented as

$$\mathsf{L} = Q_Y{}^{\sigma} Q_X{}^{1-\sigma} - \xi(P_Y Q_Y + P_X Q_X - M)$$

F.O.C.[58]

$$\frac{\partial \mathsf{L}}{\partial Q_Y} = \sigma Q_Y{}^{\sigma-1} Q_X{}^{1-\sigma} - \xi P_Y = 0,$$

$$\frac{\partial \mathsf{L}}{\partial Q_X} = (1-\sigma) Q_Y{}^{\sigma} Q_X{}^{-\sigma} - \xi P_X = 0,$$

imply that $\frac{P_Y}{P_X} = \frac{\sigma}{1-\sigma}\frac{Q_X}{Q_Y}$.

Setting P_Y as a numeraire good with price equal to 1 (i.e., $P_Y=1$), relative demand can be represented as

$$P_X = \frac{1-\sigma}{\sigma}\frac{Q_Y}{Q_X}. \qquad (A.9)$$

The autarky equilibrium in the economy can be characterized by the set of equations (*A.1-A.9*), which can be solved with respect to nine unknown variables: Q_Y, Q_X, $a_{K,Y}$, $a_{K,X}$, $a_{L,Y}$, $a_{L,X}$, w, r, P_X.

Assuming for simplicity that $\sigma = 1/2$ ($\frac{1-\sigma}{\sigma} = 1$) and $\alpha = 1-\beta$, the system of equations can be represented as follows:

[58]The Hessian of the Lagrangian is negative semi definite and thus the second order conditions to this optimization problem hold.

$$
\begin{cases}
1 = ra_{KY} + wa_{LY} \\
r = \dfrac{1-\alpha}{\alpha}\dfrac{a_{LY}}{a_{KY}}w \\
a_{LY}^{1-\alpha}a_{KY}^{\alpha} = 1 \\
P_X = \dfrac{1}{\alpha}wa_{KX}^{\frac{\alpha-1}{\alpha}} - \phi\lambda \\
\dfrac{\alpha}{1-\alpha}ra_{LX}^{\frac{\alpha}{\alpha-1}} - wa_{KX}^{\frac{\alpha-1}{\alpha}} = \alpha\phi(\gamma-\lambda) \\
a_{LX}^{\alpha}a_{KX}^{1-\alpha} = 1 \\
Q_Y a_{LY} + Q_X a_{LX} = L \\
Q_Y a_{KY} + Q_X a_{KX} = K \\
P_X = \dfrac{Q_Y}{Q_X}
\end{cases}
\qquad (A.10)
$$

Solving it with respect to P_x and rearranging, we get

$$
\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}(P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma} = \frac{1}{\alpha}\frac{L}{K}\ . \qquad (A.11)
$$

In order to determine the pattern of changes in the expected relative price P_x with respect to price fluctuations λ observed in moment Td_2 ($dP/d_x\lambda$), define the following function:

$$
H(P_X,\lambda) = \left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}(P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma} - \frac{1}{\alpha}\frac{L}{K} = 0. \qquad (A.12)
$$

Taking into account that:

$$
\frac{dH(P_X,\lambda)}{d\lambda} = \frac{d\left(\dfrac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}}{d\lambda}\left((P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right) + \left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}\frac{d\left((P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\dfrac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)}{d\lambda} =
$$

$$
\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}(P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{\alpha}{1-2\alpha}\left(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)\left\{\frac{d\left(P_X+\phi\lambda\right)}{d\lambda}\frac{}{\left(P_X+\phi\lambda\right)} + \frac{1-2\alpha}{\alpha}\frac{d(2P_X+\phi\lambda)}{d\lambda}\frac{}{\left(2P_X+\phi\lambda\right)}\right\}
$$

and

$$\frac{dH(P_X,\lambda)}{dP_X}=\frac{d\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}}{dP_X}\left((P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)+\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}\frac{d\left((P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)}{dP_X}=$$

$$\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)^{\frac{\alpha}{1-2\alpha}}\frac{\alpha}{1-2\alpha}(P_X+\phi\gamma)^{\frac{1}{1-2\alpha}}\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\left\{\frac{\frac{d\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}{dP_X}}{\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}+\frac{1-2\alpha}{\alpha}\frac{\frac{d(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma})}{dP_X}}{\left(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)}+\frac{d(P_X+\phi\gamma)}{dP_X}\right\},$$

the pattern of changes can be determined (by an *Envelope Theorem)* based on the analysis of the sign of the following expression:

$$\frac{dP_X}{d\lambda}=-\frac{\frac{dH(P_X,\lambda)}{d\lambda}}{\frac{dH(P_X,\lambda)}{dP_X}}=\frac{\left\{\frac{\frac{d\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}{d\lambda}}{\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}+\frac{1-2\alpha}{\alpha}\frac{\frac{d(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma})}{d\lambda}}{\left(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)}\right\}}{\left\{\frac{\frac{d\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}{dP_X}}{\left(\frac{P_X+\phi\lambda}{P_X+\phi\gamma}\right)}+\frac{1-2\alpha}{\alpha}\frac{\frac{d(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma})}{dP_X}}{\left(\frac{2P_X+\phi\lambda}{2P_X+\phi\gamma}\right)}+\frac{d(P_X+\phi\gamma)}{dP_X}\right\}}=$$

$$= \frac{\left\{ \frac{\phi}{P_X + \phi\lambda} + \frac{1-2\alpha}{\alpha} \frac{\phi}{2P_X + \phi\lambda} \right\}}{\left\{ \frac{d\left(\frac{P_X + \phi\lambda}{P_X + \phi\gamma} \right)}{\frac{dP_X}{\left(\frac{P_X + \phi\lambda}{P_X + \phi\gamma} \right)}} + \frac{1-2\alpha}{\alpha} \frac{d(\frac{2P_X + \phi\lambda}{2P_X + \phi\gamma})}{\frac{dP_X}{\left(\frac{2P_X + \phi\lambda}{2P_X + \phi\gamma} \right)}} + 1 \right\}}. \qquad (A.13)$$

The denominator in the expression above is always greater than zero and numerator is smaller than zero if and only if $\frac{\phi}{P_X + \phi\lambda} + \frac{1-2\alpha}{\alpha} \frac{\phi}{2P_X + \phi\lambda} < 0$. Taking into account that ϕ is always negative, the expression above can be represented as $\alpha(2P_X + \phi\lambda) > (2\alpha - 1)(P_X + \phi\lambda)$ and after rearrangement as $P_X + \phi\lambda(1-\alpha) > 0$. Since $P_X + \phi\lambda > 0$ (see *A.3*) and 0<α<1, the condition above is always satisfied, and thus

$$dP_X / d\lambda = -\frac{dH / d\lambda}{dH / dP_X} > 0. \qquad (A.14)$$

Since price fluctuations λ, which are observed at the moment of decision-making regarding labor input, is inversely related to the variation of labor market flexibility, an increase in the degree of labor market flexibility causes the expected relative price of good *X* (with respect to good *Y*) to fall. The underlying mechanism for this is the following: the higher the degree of labor market flexibility, the shorter is the time interval between moments T_3 and T_2, during which labor adjusts to changes in the market demand. Consequently, price fluctuations λ observed at time T_2 are smaller as well. And, because the price of commodity *Y* does not change, an increase in labor market flexibility decreases the price of good *X* relative to *Y* and thus makes the country more competitive in producing and exporting the commodity with uncertain demand on international markets.

Q.E.D.

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Optimal Measures of Core Inflation in the Kyrgyz Republic*

Ainura Uzagalieva**

The ideal measure of inflation should reflect long-run price movements driven by actual demand in the economy and exclude short-term supply shocks. Considering that the CPI does not correspond to such a measure, the purpose of this research is to analyze alternative methods of core (or underlying) inflation and to choose a method suitable for measuring core inflation in the Kyrgyz Republic. The results can be useful for proper monetary policy reaction to inflationary shifts in the Kyrgyz Republic.

Keywords: Kyrgyz Republic, inflation, core inflation, monetary policy, smoothing, optimality criteria.

JEL Classification: E31, E52

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1. Introduction

Inflation is one of the key issues of macroeconomic stability in transition countries, as it has a strong influence on many economic indicators such as the state budget, exchange rate, interest rate, wages, and level of poverty. Moreover, high inflation undermines the general trust in the political and economic system, impacting the inflow of direct investments. The success and efficiency of monetary policy in terms of inflation stability depends on whether an inflation measure reflects long-term price movements or includes short-term structural shocks as well. The common inflation measure in transition economies is the consumer price index (CPI). It is identified as the average weighted price level of a set of selected goods and services that are included in a consumer basket. Such an inflation measure is impacted by both monetary and non-monetary factors.

The strong impact of non-monetary factors on an inflation measure can lead to significant volatility of price changes, raising the question of whether inflation is the result of a persistent, long-term trend or reflects only short-term shifts in prices. If an inflation measure contains short-term shifts, it can significantly complicate the task of controlling inflation for policymakers. Therefore, it is important to distinguish long-term price movements which are driven by actual demand in the economy and do not respond to various short-term shocks. Such an inflation measure, which is called core inflation, is defined as a sustained change in prices induced by monetary factors. The basic motivation for using core inflation thus is to ignore short-term price shifts of a temporary nature and to consider steady underlying economic fundamentals.

The main purpose of this paper is to analyze the methods of measuring core (or underlying) inflation and to determine a more suitable measure of core inflation that excludes exogenous factors from the general inflation signal in the Kyrgyz Republic (KR). This is because the inflation measure which is used by the central bank, the National Bank of Kyrgyz Republic (NBKR), for managing inflation is based on the CPI. Since the CPI is a rather weak indicator for measuring the basic inflation trend due to its high volatility and seasonal patterns (Figure 1), the issue of measuring core inflation in the KR is essential.

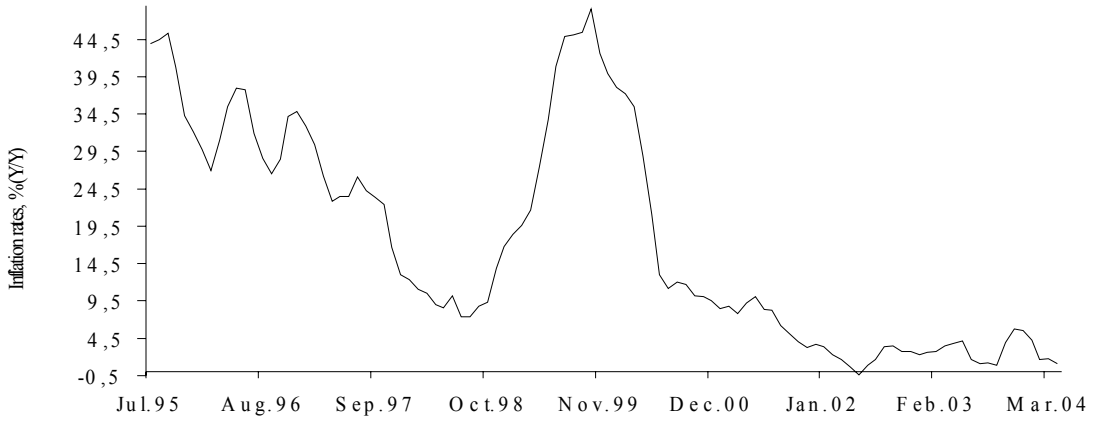


Figure 1. Inflation during July 1995 to April 2004: annualized monthly rates (Y/Y)

The high volatility and irregular fluctuations in the CPI, as depicted in Figure 1, stem from the strong impact of non-monetary factors to which the NBKR basically does not react or is not capable of influencing. The key sources of such factors in the KR are the high share of agriculture in the economy, the change of state-controlled prices and tariffs, periodicity or delays in price records, exchange rate fluctuations, and a heavy dependence on energy prices and energy products (e.g., oil products, fuel, and natural gas).

Undoubtedly, increases in prices caused by the specific factors mentioned above lead to an increase in the CPI. And, if the CPI increases beyond permissible limits, the NBKR will tighten its monetary policy. So, there is a question whether the action of the NBKR in a given situation is correct. Evidently, the presence of shocks, which are caused by short-term shocks and directly or indirectly included in the CPI, significantly complicates the main objective of the NBKR to control inflation. Besides, even if the central bank would not restrict its monetary policy, temporary shifts in the CPI caused by short-term shocks may reverberate through the economy for a much longer period. A measure that can smoothly approximate inflation would allow for more effective decision-making in the economy as a whole since short-term shifts in prices do not require a reaction from policymakers nor from other agents. Therefore, such shifts should be omitted from an inflation signal.

The paper consists of six sections with the following structure. The theoretical background for measuring core inflation and four alternative methods (e.g., exclusion,

trimmed means, standard deviation trimmed means, and percentiles) are provided in Section 2. Section 3 presents information on the system of CPI measurement in the KR and the behavior of individual prices within the CPI and reveals that the CPI in the KR does not correspond to long-term price movements. The four alternative methods of measuring core inflation are analyzed and empirical results are reported in Section 4. Then, the derived inflation measures are compared in terms of a smoothness property by minimizing their distance from a smoothed CPI time series in Section 5. Section 6 summarizes the main findings and concludes with general remarks.

2. Conceptual framework

The concept of core inflation is rather new in the literature; it was first formally defined by Eckstein (1981) at the beginning of the 1980s. According to Eckstein core inflation is "the rate that would occur on the economy's long-term growth path, provided the path were free of shocks, and the state of demand were neutral in the sense that markets were in long-run equilibrium."[59] Eckstein linked the overall inflation measure in a Phillips curve equation to the following: the expected inflation measure, the gap between the actual and potential levels of economic activity, and the aggregate supply shocks. Then, he defined core inflation as the expected inflation. In the 1990s, the central banks of many countries[60] adopted inflation targeting regimes (Haldane 1995; Neumann and von Hagen 2002). Since the primary objective of the central bank under this regime is to maintain inflation within targets, the problem of measuring core inflation became urgent. This stimulated further studies and contributed to the development of somewhat different concepts as well as measures of core inflation.

Today, there is a wide range of literature worldwide concerning the issue of measuring core inflation. An example of work measuring core inflation in New Zealand is presented by Roger (1995, 1997). Research focused on measuring core inflation in the United States, Canada and Western Europe includes Arrazola and Hevia (2001), Blinder (1997), Bryan and Cecchetti (1993, 1994, 1995, 1996), Bryan, Cecchetti and Wiggins

[59]See Eckstein (1981).
[60]Australia, Brazil, Canada, Chile, Czech Republic, Hungary, Israel, New Zealand, Peru, Poland, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, and the United Kingdom adopted an inflation targeting regime over the last decade.

(1997), Cecchetti (1995, 1996), Claus (1997), Clark (2001), Cutler (2001), Johnson (1999), Smith (2004a, 2004b), and Quah and Vahey (1995). At the end of the 1990s, work on core inflation appeared in transition countries as well (Charemza, Makarova and Parchomenko 2000; Wozniak 1999). The methodology of measuring core inflation described in the cited literature can be divided into two main approaches: one is based on statistical methods and the other approach, the modeling approach, focuses on a conceptual problem - the problem of defining core inflation.

A structural approach to modeling core inflation was originally described in the paper of Quah and Vahey (1995). The theoretical framework behind this approach is that in the long run, inflation reflects the state of demand in an economy and does not influence the real output. However, unexpected inflationary shocks could cause significant shifts in the economic structure and thus in real output in the short and middle terms. According to Quah and Vahey (1995), inflation measurement based on the CPI could be erroneous because of its high sensitivity to various non-monetary factors. In this respect, the authors suggest breaking the inflation measure into core and residual parts using a time series of aggregated CPI data. Core inflation is the component of inflation that does not influence the real output in the long run and reflects the state of demand in an economy.

An approach based on statistical methods was initially provided in the papers of Bryan and Cecchetti (1993, 1994), Bryan, Cecchetti and Wiggins (1997), Cecchetti (1996). Generally, this approach is applied to disaggregated CPI data using cross-section and time-series methodologies. The cross-section methodology deals with constructing core inflation on a period-by-period basis using information on the CPI across its components (Bryan and Cecchetti 1993, 1994; Bryan, Cecchetti and Wiggins 1997; Cecchetti 1996; Wozniak 1999). Bryan and Cecchetti defined core inflation as "the component of price changes which is expected to persist over the medium-run horizon of several years."[61] According to the time-series methodology, core inflation is measured based on the statistical properties of the time-series in the disaggregated CPI data (Blinder 1997; Cutler 2001; Smith 2004a, 2004b). This methodology is focused on measuring core inflation with high predictive power through three steps: *(1)* choosing

[61]See Bryan and Cecchetti (1993).

time-series that produce better forecasts from the components of CPI; *(2)* finding the optimal weights; and *(3)* re-weighting CPI components in a way that the chosen time-series (in step *1*) have larger weights.

The statistical methods of analysis, which are applied to the cross-sectional variation of prices, distinguish two basic categories of problems: noise and bias. Noise refers to all temporary shocks which do not impact prices in the long run and fade away with time, however, such shocks have a strong influence on prices in the shorter frequencies (e.g., month and quarter). Bias is related to a change in weights if CPI is calculated based on permanent weights (if CPI is calculated on constant weights the weighting bias becomes insignificant) or to measurement errors. The measurement errors arise from the possibility of mistakes when recording the price of a good. In the literature (Bryan, Cecchetti and Wiggins 1997; Cecchetti 1996; Hanousek and Filer 2001a, 2001b; Roger 1995, 1997; Wozniak 1999), four alternative methods of defining core inflation are described: the exclusion method, the trimmed means method, the standard deviation trimmed means method, and the percentile method. A brief overview of each method is presented below.

2.1. Exclusion method

The exclusion method omits certain categories or whole groups of goods and services from CPI prices which are traditionally highly sensitive to supply shocks and are usually self-transient. Such categories are, for example, agricultural goods, electric power, natural gas, other kinds of fuel, and tobacco. The agricultural goods (e.g., grains, fresh fruits and vegetables) are the most highly volatile component due to their high sensitivity to seasonal factors and natural supply shocks, so the rational for excluding these components from the basket is pretty obvious. With regards to electric power and natural gas, the main reasons why economists decided to include them in that category were derived from the oil shocks of the 1970s (Clark 2001). Later when oil markets recovered from the shocks, it was recognized that even if oil prices are not as volatile as the prices of agricultural foods, they still could largely be influenced by supply shocks. The same reasoning is true for the state-controlled goods and services or price controls (i.e., regulated industries). Therefore, the exclusion of all these items should yield an

inflation measure that is close to the central tendency and reflect the state of demand in the economy (Roger 1995, Wozniak 1999). This method zeros out the weights of goods to be excluded from the basket when calculating the weighted-average level of prices.

However, this method has serious disadvantages if seasonal factors are important as in an economy like the KR, for example, due to the high share of agriculture. Besides, expenses on foods, energy and rental fees, which should be excluded from the basket, might represent the largest portions of families' budget, especially in low-income countries. Under these circumstances, the intuitive exclusion of too many components from the basket may result in excluding not only noise and bias, but also a signal, increasing the chance of losing important information. This would make the concept of core inflation too suspicious for the public. Therefore, one has to be very careful in choosing the number of goods from the basket for exclusion in order to avoid the possibility of losing important information.

2.2. Trimmed means method

The trimmed means method is the systematic exclusion of the largest jumps and falls in prices no matter what group of goods they belong to. By zeroing out the weights, the maximal spikes and minimal drops are excluded from a range of price fluctuations in a given period of time, and then the average weighted price of the rest is calculated. This method allows one to lower the undesirable properties of the sample mean (such as maximal dispersion, bias, abnormal distribution), and therefore, it has attracted much attention from the majority of central banks. According to Wozniak (1999), the intuition behind this method is that the sample mean gives a distorted estimation of true inflation due to extraneous price disturbances. Therefore, the approach argues for a symmetric exclusion or rejection of a given percentage of data with extreme jumps or falls (minimum and maximum) from the distribution of prices. If distribution is symmetric relative to average prices, the exclusion of extreme values does not change the sample mean. But, if distribution is asymmetric, exclusion changes the sample mean upward (positive asymmetry) or displaces it downwards (negative asymmetry). Positive asymmetry specifies that distribution is skewed towards positive values, and negative asymmetry specifies that distribution is skewed towards negative values. If the

distribution of prices were approximately normal, then the sample means from that distribution could be the best estimator of the true mean because it would be unbiased.

The economic motivation of the trimmed means method is mainly related to the dynamics of relative prices, which temporarily affect the aggregate price level, causing upward or downward short-term shifts. There are various theoretical models attempting to explain the causal relationship between relative prices and the inflation level. According to these models, the shape of price distributions gives basic intuition on how individual price changes contribute to the general inflation level. In particular, there are models which show that large fluctuations in relative prices cause higher inflation (Ball and Mankiw 1994, 1995), and on the contrary, there are models showing that an increase in inflation causes a fluctuation of relative prices (Mussa 1977; Shleshinski and Weiss 1977). The main link between individual price changes and the aggregate inflation level is the behavior of firms. Ball and Mankiw (1995) explained this link using a concept of menu costs which states that a firm's response to inflation depends on whether its price adjustments are costly or not. If price adjustments are costly for a firm, it will not change its prices. However, if inflation is so high that by adjusting prices an enterprise can avoid certain losses, it will increase its prices as well.

2.3. Standard deviation trimmed means method

The standard deviation trimmed means method is based on the exclusion of all extraneous price jumps or falls if in a given month some prices increased or decreased too strongly compared to the same months of other years. The details are considered by Bryan, Cecchetti and Wiggins (1997), and Wozniak (1999). The basic idea of the method is to exclude all price jumps or falls in a given period that are more remote compared to the change of prices in the corresponding periods included in the whole sample. At the same time, it is possible to throw out price jumps asymmetrically. For example, if in any period there was strong inflation resulting from a sharp jump in certain prices (e.g., distribution is skewed towards positive values), then exclusion will eliminate variables only at the one end. Only large jumps are omitted, thus it is suggested to exclude the highest price jumps or falls on a period-by-period basis. The main drawback of the method, however, is the fact that prices are excluded without knowledge of the sources of

noise. Consequently, this method can discard pretty useful information in prices if outliers contain important news as, for example, the change of state controlled prices that play a very important role in forming price expectations for future periods.

2.4. Percentiles method

Lastly, the basic idea of the percentile method concerns achieving an unbiased estimator. Since the sample mean is the unbiased estimator of the true mean, the percentile of price distribution corresponding to the sample mean should also be an unbiased estimator of the mean of empirical distribution (Roger 1997; Wozniak 1999). For instance, the sample mean of the CPI corresponds to the 50^{th} percentile at the symmetric distribution of prices. With positive asymmetry, when the distribution is skewed to the right, the percentile of underlying inflation is above *50*. With negative asymmetry, when the distribution is skewed to the left, the percentile is below *50*. In other words, the k-percentile of core inflation is defined as the k-percentile of the weighed distribution of price changes during a given time and the median CPI always corresponds to the 50^{th} percentile. Clearly, the median CPI or the 50^{th} percentile of the CPI will not always correspond to the mean of the CPI depending on the shape of the distribution. Therefore, the task of the method is to compare all price distributions within the CPI and find those percentiles which correspond to the sample mean.

In comparison to other methods described above, this method takes into account all the available observations. The key of the analysis is based on the proposition that the distribution of price changes within the CPI in a certain period presents an individual sample in the whole population of price distributions. Such samples are interpreted as the set of underlying price changes. The most acceptable way of comparing the underlying price changes across different periods is to use the whole empirical sample of distributions. The fact that the method takes into account all the available observations is very attractive and useful for less advanced transition economies where the price setting mechanism is still adjusting to a market one.

2.5. Optimality criteria

The accuracy of inflation measures derived on the basis of the four alternative methods is to be assessed in accordance with an optimality criterion. However, there is no one formal criterion by which the accuracy of core inflation measure can be assessed. Therefore it is reasonable to choose criteria based on their suitability to monetary purposes. The literature considers the following important attributes or criteria desirable for core inflation (Wynne 1999). The suitability of core inflation as the indicator of current and future inflation is necessary. This implies that the ideal inflation measure is a smooth measure that closely approximates the general inflation trend. Timeliness and computability in real time is another important issue, so that history does not change much upon including new data. It should be transparent enough for the public and policymakers. This attribute suggests that the public might challenge a measure which excludes too many goods from the consumer basket as it can significantly deviate from the true cost of living index. In addition, the core measure should follow the same trend as the headline inflation, i.e., there should be a close relationship between measured and core inflation.

Taking into account the above-mentioned attributes, the property of smoothness receives the main attention in this paper. The optimality criteria for choosing the efficient measure of core inflation are the comparisons of the root mean square error (further RMSE) and the mean absolute deviation (further MAD) relative to a benchmark trend. The 12^{th}, 24^{th} or 36^{th} monthly moving average trends, which are initially proposed by Bryan and Cechetti (1995, 1996, and 1997), were adopted as the benchmark trend in many studies (see, for example, Wozniak 1999; Berkmen 1999; Clark 2001). However, since these criteria are arbitrary, alternative smoothing methods are experimented in this study and based on minimizing their standard deviations around the actual inflation rates, the benchmark trend is chosen. This issue is more carefully addressed in section 5.

3. The CPI as a measure of inflation in the Kyrgyz Republic

One of the key decisions the government of the KR took to eliminate hyperinflation at the beginning of the 1990s was to introduce a national currency (KGS) under a floating exchange rate regime. As a result, a typical two-tiered banking system,

including a central bank and commercial banks, was established. According to the law[62] on the NBKR, the main purpose of the central bank is to manage inflation that is measured by the CPI. The NBKR influences the money market through traditional instruments of monetary policy.[63] The exchange rate is freely determined on the basis of spot and other exchange rates on the foreign exchange market.[64]

The dynamic of inflation measured by the CPI and basic macroeconomic indicators during 1992-2004 is demonstrated in Table 1 (in the Appendix). The period of severe hyperinflation and deep structural imbalances is 1992-1994, when annual inflation reached the four-digit level as the immediate result of trade and price liberalization and the introduction of the value-added tax. During 1995-1997, inflation fell to the two-digit level and most macroeconomic indicators improved significantly. However, the financial crisis in Russia, which heavily hit the economy of KR in 1998, intensified a potential internal crisis and led again to high inflation. According to the NBKR,[65] the effect of monetary policy measures taken to reduce inflation during 1998-1999 was displaced by the influence of external non-monetary factors beyond the control of the NBKR. As the crisis events faded, prices began to stabilize and the improvement of the external conditions regarding the KR contributed to a decrease in the inflation rate during 2000-2004.

The official inflation data of the KR can be obtained from the National Statistics Committee of the KR (NSC KR) through publications and WebPages (http://nsc.bishkek.su). The price indexes published by the NSC KR include the producer price index, the agricultural price index, and the consumer price indexes. The CPI is measured by the Laspeyres formula:

$$CPI^t = \frac{\sum_{i=1}^{K} p_i^0 q_i^0 \frac{p_i^t}{p_i^0}}{\sum_{i=1}^{K} p_i^0 q_i^0}. \qquad (1)$$

[62]The policy-making board of the central bank is insulated from politicians and is given exclusive power in setting the instruments of monetary policy in order to maintain its primary goal, price stability.
[63]Nowadays the most actively used instrument of monetary policy in the KR is open market operations.
[64]Pursuant to the Law of the Kyrgyz Republic "On Operations in Foreign Exchange" as of 05.07.95, No 7-1, Article, the activity of the NBKR on the foreign exchange market is limited to smoothing abrupt fluctuations in the exchange rate, while keeping international reserves at an adequate level, i.e., it allows speculative shocks.
[65]See Annual Report of NBKR (1998).

The consumer basket of the average city dweller in the KR includes at present *343* goods and services *(K=343)*, which are divided into three large groups - foods, non-foods and paid services. The weights of the index *(q_i^0, i=1,2, ...,K)* are determined on the basis of actual consumer expenses in the base period. The structure of these expenses is established by the state budget inspections over the whole population of the KR.

The NSC KR changed the structure of the consumer basket three times. The first change took place in 1995 when the Parliament of the KR altered the minimum level of the consumption budget. The next change was in 1998, when it included services in the consumer basket (education, public health and notary offices) as separate observations. And, in 2001, the number of components in the basket was increased from *305* to *343*. As a result, during 1992-2003, the share of paid services increased from *11%* to *15%*, the share of non-foods decreased from *32%* to *27%*, and the share of foods stood at the level of 1992, which accounts for *58%*. The sample of the CPI used in this paper, therefore, covers *305* categories of consumer goods for the period of July 1995 to December 2001 and *343* categories for the period January 2002 to April 2004. The CPI is presented as the weighted average of individual CPIs of all components, i.e.,

(2) $$CPI_t = \sum_{i=1}^{K} w_{i,t}\pi_{i,t} \ ,$$

where w_{it} is the weight of *i'*s component of the CPI in period *t*, and π_{it} is individual inflation of *i'*s component in period *t*. The $w_{i,t}$ in formula *(2)* is defined as

(3) $$w_{i,t} = \frac{p_{i,t-1}q_i^0}{\sum_{j=1}^{K} p_{j,t-1}^0 q_j^0} \ ,$$

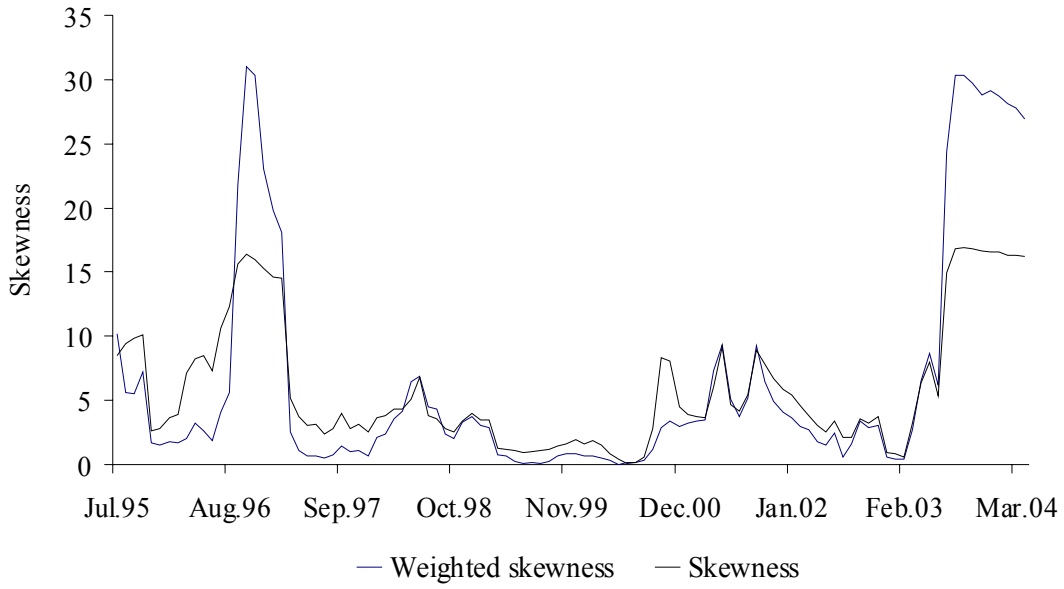
which means that $w_{i,t}$ is not a constant, but depends on the period chosen as the basis. There are several possibilities: *(1)* previous month, *(2)* December of the previous year, and *(3)* the same month or period of the previous year. The constants are q_i's, which represent the structure of actual consumption expenses in the base period. Consequently, under the calculation of monthly CPI, the weights $w_{i,t}$ change every month because absolute and relative prices also change every month. The same phenomenon occurs when the quarterly inflation rates are calculated.

To see the rational for determining a core inflation or long-run inflation measure in the KR, it is necessary to obtain a picture of individual CPI distributions for all components; in statistical terms it is necessary to calculate the basic descriptive statistics of those distributions, i.e., *mean*, *variance*, *skewness*, and *kurtosis*. The necessity to calculate descriptive statistics stems from the fact that they give basic intuition on how individual price changes contribute to the general inflation level. Since the monthly data for the KR contain a seasonal pattern that has a period of approximately *12* months, we apply one *12*-month differencing between periods *t* and *t-12*. This allows a decrease in variance caused by the seasonal pattern. Consequently, at monthly frequency the above-mentioned statistical moments are calculated using annualized monthly (Y/Y) data.

When plotting the distributions of individual price changes in the CPI, the weights of the consumption basket are used as the number (or frequency) of having equally weighted individual inflation components in the total CPI. In other words, the weights represent the probability of having a certain level of individual inflation rate in the total CPI. The skewness and kurtosis of monthly, quarterly and annual distributions of individual inflation rates are shown in Table 2 (in the Appendix). According to the literature (Green 2001), normal distributions are characterized by the kurtosis equal to *3*. However, in the case of the KR, both the mean and median of kurtosis at each frequency are much higher than *3*, meaning that the sample distributions are not normal. Such price distributions (high kurtosis and excess positive skewness) are evidence of big price jumps which dominate the inflation process.

To see a more accurate picture of price distributions on the basis of KR data, the dynamic of weighted and unweighted skewnesses is drawn on the basis of annualized monthly inflation rates. Figure 2 demonstrates that the peak of skewnesses is marked in 1996 and the second highest point takes place in 1995.

a) Skewness



b) Kurtosis

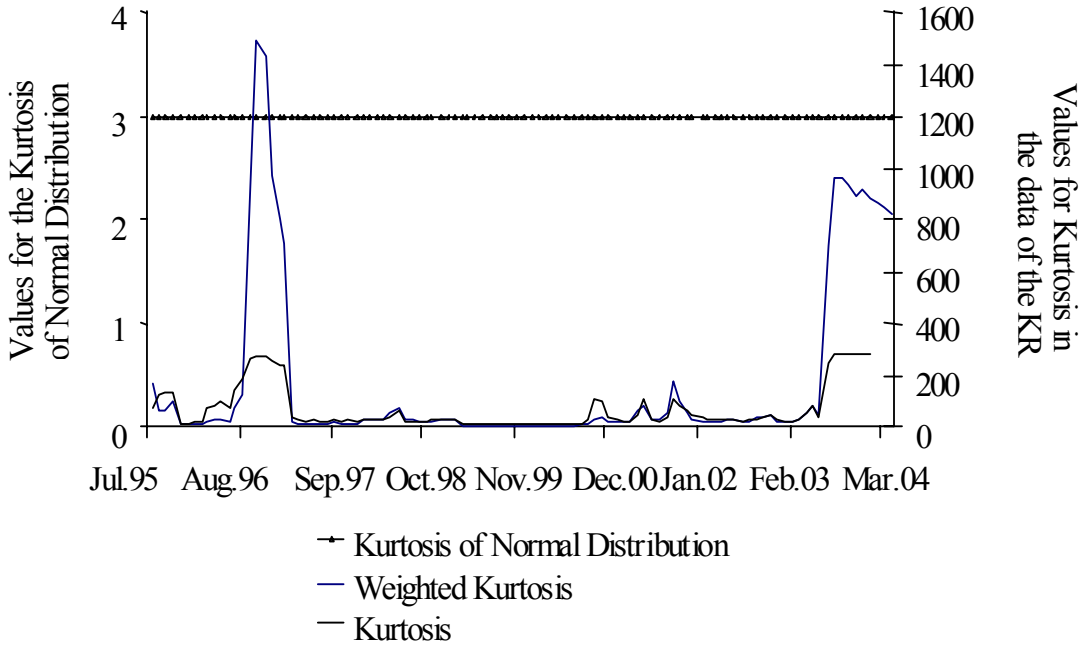


Figure 2. The descriptive statistics of price distributions in the period of moderate inflation (January 1995 to December 2000): a) skewness; b) kurtosis

In all subsequent years (except 2000), there is a clear tendency of the coefficient of skewness to decline; however, price distributions remain positively skewed. The shape of the price distributions, in particular high points presented in Figure 2, show the fact that large price adjustment processes in the economy of the KR took place in 1995, 1996 and 2003.

The government abandoned price controls on alcoholic drinks, tobacco, some items related to housing except electricity, gas and hot water supply, and notary services during these years. Besides, a number of important programs and projects, which were focused on achieving social progress by means of domestic resources,[66] supporting the small business sector,[67] and providing private enterprises in agricultural and tourism sectors with financial and technical assistance,[68] were adopted as well in 1995-1996. Within such projects and programs over a thousand business plans were prepared and implemented in order to provide small business sectors with training, technical assistance, expert service and financial resources. Reform measures were also taken in the public and state sectors in order to lay off low qualified personnel and reduce inefficient state facilities and services.

Consequently, price reforms, job creation in the real sector through opening new private small and medium-sized firms, and an increase in the demand of labor, especially, in reviving sectors such as agriculture, trade, catering, and services, stimulated large structural changes in the economy. The shapes of price distributions, which are shown in Figure 2, presumably indicate just how sensitive inflation is to such structural shifts in the economy, since the distribution of prices is asymmetric if the inflation level is sensitive either to positive or negative shocks in the economy. In general, the dynamics of prices within the CPI, in particular, strongly asymmetric price distributions, indicate the fact that the CPI is highly sensitive to factors that cause short-term shifts in prices. In other words, the influence of non-monetary factors on prices, as it is mentioned in Section 1, which are beyond the direct control of the NBKR, is high in the KR.

[66]See, for example, the long-run development strategy named the National Strategy for Sustainable Human Development (NSSHD).
[67]See, for example, the Program of United Nation Industrial Development Organization (UNIDO) focused on the technical assistance to small and medium size enterprise development.
[68]See, for example, the Program of the Swiss agency Helvetas.

As it is shown, seasonal pattern and irregular fluctuations characterize the dynamic of the CPI, which contains *343* components. In this respect, the cross-section rather than the time-series methodology is applied in order to disregard temporary shifts in the general inflation signal. This is because of the large number of time-series to be forecasted, consequently, the large amounts of random variation under a relatively short time span in the CPI data would, generally, lower the forecasting performance of the time-series models (Franses and van Dijk 2005; Miler and Williams 2003). Therefore, this study focuses on the variation of components within the CPI and analyze four alternative methods (e.g., exclusion, trimmed means, standard deviation trimmed means, and percentile) of measuring core inflation.

4. Model specification and estimation results

Cecchetti (1996) provides a rather simple technique, connecting concepts mentioned in section 2 with the formulas in several steps. A change in the price of individual goods in the consumer basket (*i*) is defined by the expression

(4) $$\dot{p}_{i,t} = \dot{P}_t + \dot{x}_{i,t} \ ,$$

where $\dot{P}_t$ is a trend change and a most suitable measure of core inflation, and $\dot{x}_{i,t}$ is relative inflation, which reflects a simultaneous burst caused by a change in the price of an individual component in the consumer basket. The CPI is the weighted average of all basket components, i.e.,

(5) $$\pi_t = \sum_i w_{i,t} \dot{p}_{i,t} .$$

Summing up the above mentioned expressions, we obtain

(6) $$\pi_t = \dot{P}_t + \sum_i w_{i,t} \dot{x}_{i,t} \ ,$$

where the second term represents the group of noises (n_t) and bias (b_t) tied to core inflation $\dot{P}_t$ for all *t*; more precisely,

(7) $$\pi_t - \dot{P}_t = \sum_i w_{i,t} \dot{x}_{i,t} = n_t + b_t \ ,$$

where n_t is a stationary noise with zero mean and b_t is a bias that could be represented as $b_t = \mu_b + \omega_t$ (μ_b and ω_t are the bias of measurements and weights, respectively).

If the inflation of an individual component i in k is determined as

(8) $$\dot{p}^k_{i,t} = \frac{p_{i,t+k} - p_{i,t}}{p_{i,t}} \ ,$$

since the inflation of an individual component in the expression *(8)* is obtained from the measure of individual price change

(9) $$\pi^k_t = \dot{p}^k_{i,t} = \frac{1}{k}\overbrace{[\ln(p_{i,t+k}) - \ln(p_{i,t})]}^{\bullet} = \frac{1}{k}\overbrace{\ln(\frac{p_{i,t+k}}{p_{i,t}})}^{\bullet},$$

then the result will be the following specification of inflation:

(10) $$\pi^k_t = \dot{P}^k_t + \mu_b + \sum_{j=1}^{k}(\omega_{t+j} + n_t) \ .$$

At a rather large value of k (considering the assumption that stationary noise has zero mean), the bias resulted from the change of weights and stationary noise cancel each other out and the last component of the expression *(10)* turns to zero. The bias of μ_b measurements can be derived from existing data as a difference between the actual CPI time series and core inflation measure. The efficient measure of core inflation is defined by comparing inflation measures, which are derived using the above-mentioned four alternative methods, on the basis of their RMSE and MAD relative to the benchmark trend. Therefore, the question of choosing an adequate benchmark trend is crucial for deriving a core inflation measure.

Previous studies focused in measuring core inflation (Berkmen 1999; Bryan and Cechetti 1995, 1996, and 1997; Wozniak 1999; Clark 2001) chose arbitrarily centered

moving averages (CMA) as the benchmark trend. The CMA based benchmark trend appears to be irrelevant for the data of the KR, since it does not closely approximate the general inflation trend in the KR (Figure 3).

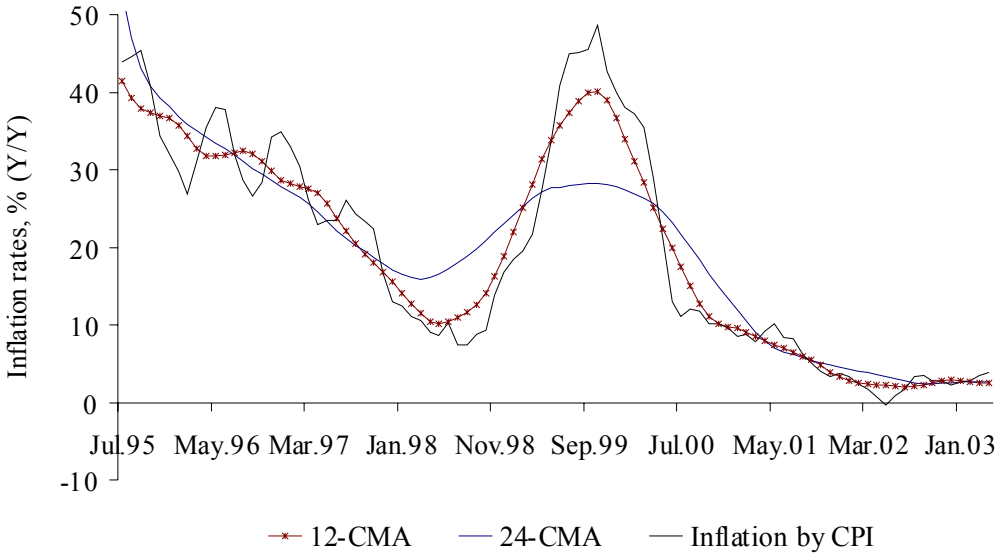


Figure 3. Centered moving averages and the actual inflation rates

As Figure 3 shows, there is a "slow" reaction of CMAs, which include *12* and *24* month periods, to actual CPI rates. In particular, the CMA trends either overstate in some periods or understate in other periods the time series of the CPI. Therefore, other alternative smoothing and filtering methods are included in the study. These are the Hodrick-Prescott (HP) filtering, logarithmic smoothing, powered smoothing, and the polynomial trends. To choose the appropriate benchmark trend from the set of simulated trends, the standard deviation of each series from the actual inflation rates are computed and compared. Then, based on minimizing these deviations, the Hodrick-Prescott filter with the smoothing parameter *10* (HP-10) is chosen as the benchmark trend. Figure 4 demonstrates further that this trend closely approximates the dynamics of the actual inflation rates.

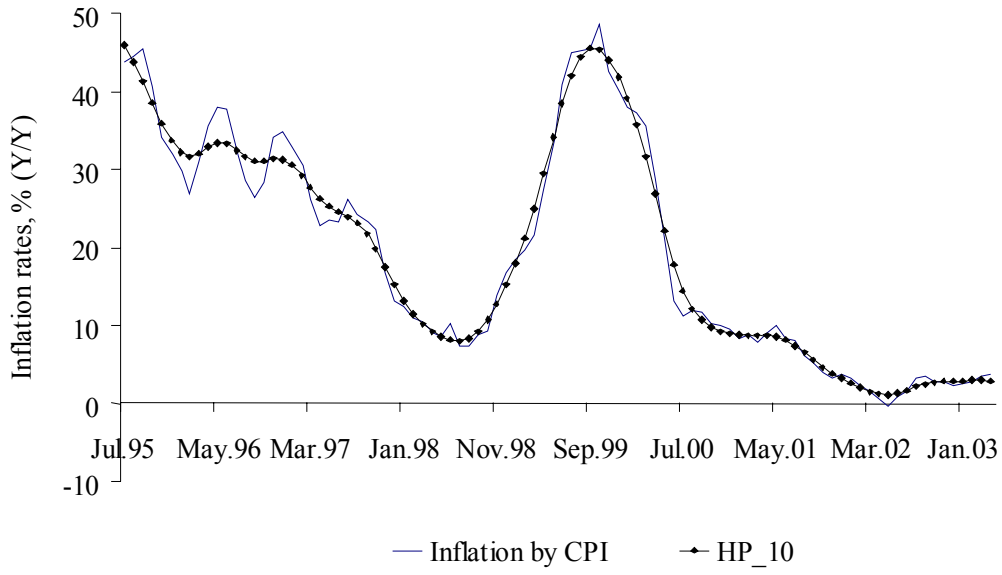


Figure 4. Benchmark trend: a Hodrick-Prescott filter

The alternative inflation measures derived by our four methods are compared with the benchmark trends on the basis of MAD and RMSE, which are defined as follows:

(11) $$MAD = \frac{1}{N}\sum_{i=1}^{N} | y_i | \quad , \text{and}$$

(12) $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N} (y_i)^2},$$

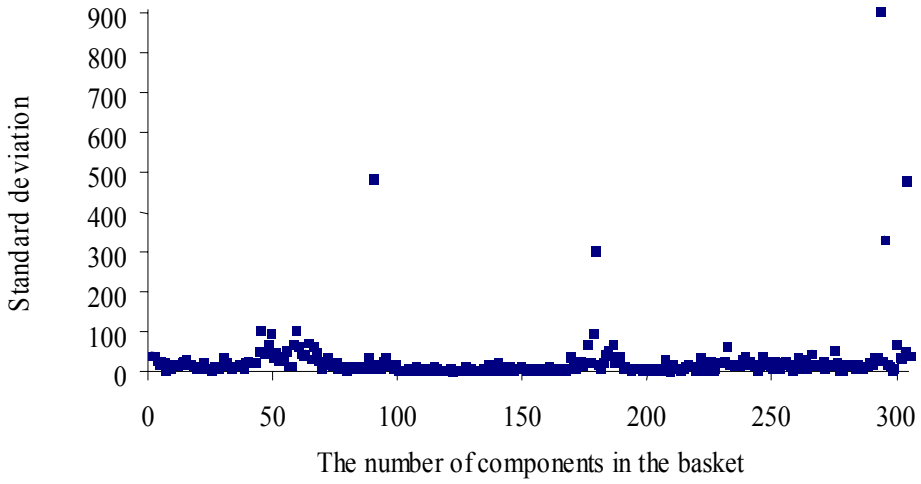
where y_i is the distance between the derived inflation measure and the benchmark trend. Computed MAD and RMSE for all estimators are sorted in ascending order and better measures derived by each method are chosen. Below means obtained by the alternative four methods are examined in detail.

4.1. Exclusion method

The preliminary analysis of individual price changes in the KR for the period July 1995 to April 2004 shows significant price fluctuations. The standard deviations of individual CPI prices across time, which are calculated on the basis of annualized monthly data (*Y/Y*), vary greatly; the lowest value of deviations is *3.4*, while the highest is

905.1. The standard deviation of CPI components across time throughout the whole period considered is shown in Figure 5(a). The five most volatile components are cologne, garlic, notary services, lipstick, and rent (per sq. m). After excluding these components from the basket some outlying items, which fluctuate greatly, still remained in the sample [Figure 5(b)].

a)



b)

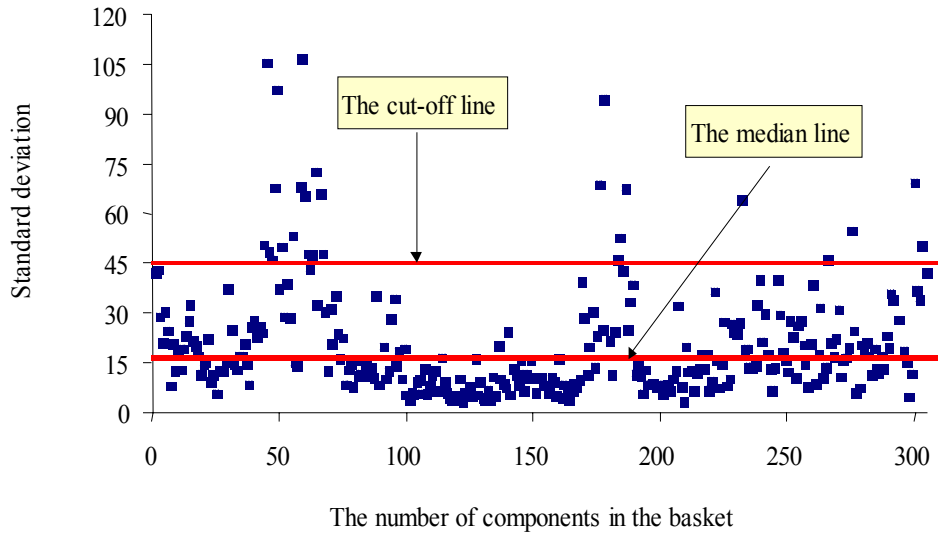


Figure 5. The standard deviation of individual price changes: a) including 5 highly volatile components; b) excluding 5 highly volatile components

These outlying items are at least twice as variable as the items lying at the median level of the standard deviations. Therefore, in order to exclude too volatile components from the basket, a cut-off point for exclusion is defined as the product of the median level of standard deviations for the annualized monthly inflation, which is *15.03*, and *2.50*. The components whose standard deviations exceed the cut-off point, which is *45.09*, are excluded from the CPI.

The total number of goods and services excluded from the basket is *31*, which are fruits and vegetables, rental fees, and imported goods (Table 3 in the appendix). The exclusion of these components from the basket significantly improves the inflation measure; its deviation from the benchmark trend measured by both RMSE and MAD is the lowest. However the suitability of this method to the conditions of the KR is questionable. The reason for this is that due to the high share of agriculture in the economy of the KR, policymakers pay great attention to the seasonal factors that cause price changes. Besides, expenses on foods, energy and rental fees, which are excluded from the basket, compose the largest portion of families' budget. The size of weights, which are zeroed out systematically under the calculation of the average-weighted price of the rest of the components in the basket, is *0.1883*, on average, for 1995 to 2003. In other words, about *20%* of all information is thrown out every time when calculating core inflation. Under these circumstances, the intuitive exclusion of components from the basket might increase the chances of losing important information and make the concept of core inflation too suspicious for the public.

4.2. Trimmed means method

The trimmed means method is based on regular removal of the greatest jumps, allowing one to lower the undesirable properties of a sample mean. An intuitive explanation is as follows: the sample mean gives a distorted estimation of true inflation due to extraneous price disturbances. In the case of the KR the population distributions of CPI changes is not normal, not known, and vary over time, so finding a good estimator is problematic. In this regard, the author uses the fact that the sample mean is a function of the random variables: $CPI_1, \ldots, CPI_{343}$. It is also considered that, theoretically, the distribution of the sample mean can be found through using two characteristics of

distributions: the mean and variance which do not depend on the density $f(\cdot)$. Therefore, the trimmed mean estimators, which are devised from means, can be examined and compared. To find the efficient trims, the CPI distributions are trimmed at monthly frequency using the annualized monthly data.

According to the technique, which is in detail described and tested by Berkmen (1999), Nyman (1999), and Wozniak (1999), the components of the CPI are ordered in ascending order ($CPI_1, \ldots, CPI_{343}$ according to the value of CPI) with their appropriate weights ($w_1,\ldots,w_{343}$). Then, W_i is defined as a cumulative weight from j (the first component assigned for averaging) to i (the last component assigned for averaging) as $W_i = \Sigma w^i_j$ in order to determine the set of observations for averaging, i.e., i components such that

$$\alpha/100 < W_i < (1- \alpha /100) \; . \tag{13}$$

Consequently, the obtained set of CPI components (i.e., I_α) used for calculating the weighted trimmed means is

$$\chi_\alpha = (1/ (1- 2\alpha / 100)) \sum_{i \in I\alpha} w_i * CPI_i \tag{14}$$

The weighted trimmed means can represent two special cases: the sample mean, χ_0; and the sample median, χ_{50}.

The procedure is performed with the *1%* step of trimming, starting from *1%* of the observations and ending with *49%*, from both tails by the weights of the consumer basket. By sorting derived means according to RMSE and MAD, 6 better performing measures from the set of *49* trimmed means are chosen (Table 4 in the appendix). However, none of these measures, which are *1%*, *2%*, and *3%* of trimming from both tails of distributions, can sufficiently smooth the inflation measure during the whole period of the sample. This is because the general inflation level is much more volatile during 1995-2000 compared to subsequent years. Therefore, the author decided to compare the RMSE and MAD of the derived means for the periods July 1995 to December 2000 and January 2001 to April 2004 separately. According to the results, one

can smooth the time series of CPI rates by omitting only *2%* of observations during the first period, while excluding *26%* of observations is necessary during the second period to minimize the distance of the derived measure from the benchmark. In general, in high inflation periods a smaller percentage of trimming is sufficient, and in the periods of moderate inflation, trimming with larger percentages is preferable.

4.3. Standard deviation trimmed means method

For measuring core inflation by this method, the extraneous jumps or falls of prices should be excluded from the distribution of individual price changes, leaving the remaining prices for averaging. The literature suggests that observations above and below *1* to *3* standard deviations from the mean be discarded (see, for example, Wozniak 1999). The reason for this is that the normally distributed variables contain 68.2% of observations within *1* standard deviation from the mean, *95.4%* of observations within *2* standard deviation from the mean, and *99.8%* of observations within *3* standard deviation from the mean (Green 2001). Thus, it is suggested to exclude outlier price jumps or falls on a period-by-period basis.

To find the cut of points for the CPI data of the KR, first, the standard deviations of individual price changes within the CPI are calculated on the period-by-period basis. An example of monthly price deviations on the period-by-period basis is presented in Figure 6.

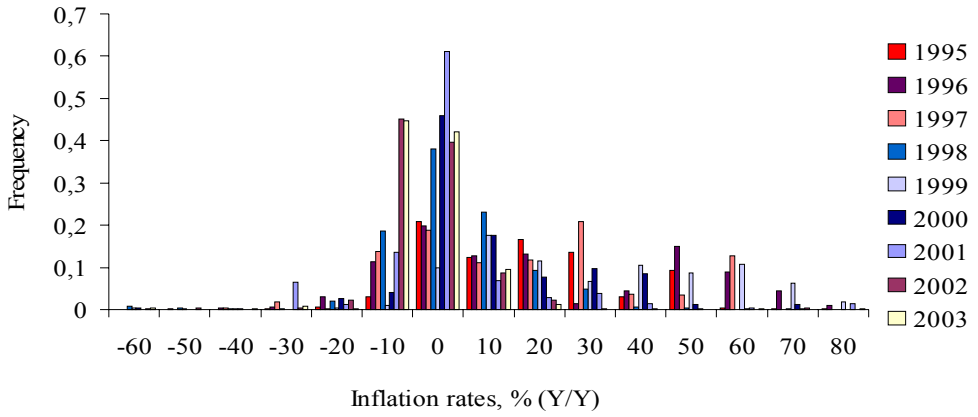


Figure 6. CPI on the period-by-period basis: covering only the months of September during 1995-2003

It should be noted that the empirical distributions of individual price changes have a very wide range. The same is true for the standard deviations of price changes on the period-by-period basis. Therefore, exclusion from the CPI is applied with varying standard deviations, depending on the range of their medians. Five alternative measures are calculated for the whole sample period and separately for the periods with highly volatile dynamic of inflation (January 1995 to December 2000) and less volatile dynamic of inflation (January 2001 to April 2004). These are the means obtained by excluding jumps and/or falls above and below *1*, *1.5*, *2*, *2.5*, and *3* standard deviations. For each resulting trimmed set of observations, i.e., for each standard deviation, the weighted-average level of prices are computed and compared against the benchmark trend.

The comparison of obtained means with the benchmark trend on the basis of RMSE and MAD shows that the optimal threshold of trimming is above and below *3* standard deviations for the period 1995-2000 and above and below *1.5* standard deviations for the period 2001-2004. In other words, during the periods of high price volatility, a smaller percentage of exclusion (i.e., below and above *3* standard deviation) improves the behavior of the inflation measure at which both the RMSE and MAD values around the benchmark trend are low. During more tranquil periods, however, exclusion with a more narrow range of cut-off points (+-*1.5* standard deviation) is desirable (see Table 5 in the Appendix). We should remark that prices are excluded without knowledge of the sources of noises. Consequently, this method can discard useful information if outlier prices contain important news, for example, the change of state controlled prices that play a very important role in forming price expectations. This is the main drawback of the method.

4.4. Percentile method

The essence of the analysis is based on the assumption that the empirical distribution of price changes, which we observe each month (quarter, year), is the individual sample of the whole population of price changes. Consequently, we compare the set of changes in underlying prices. The most acceptable way to make such a comparison is to use the empirical sample of distributions. It is achieved by smoothing all possible normalized observations both by CPI components and time periods on each

frequency of observation (Roger 1997; Wozniak 1999). At the symmetric distribution of individual prices (median), the percentile of underlying inflation is equal to *50*. Figure 7 demonstrates the sample mean percentiles calculated over the entire sample period of KR data at monthly frequency.

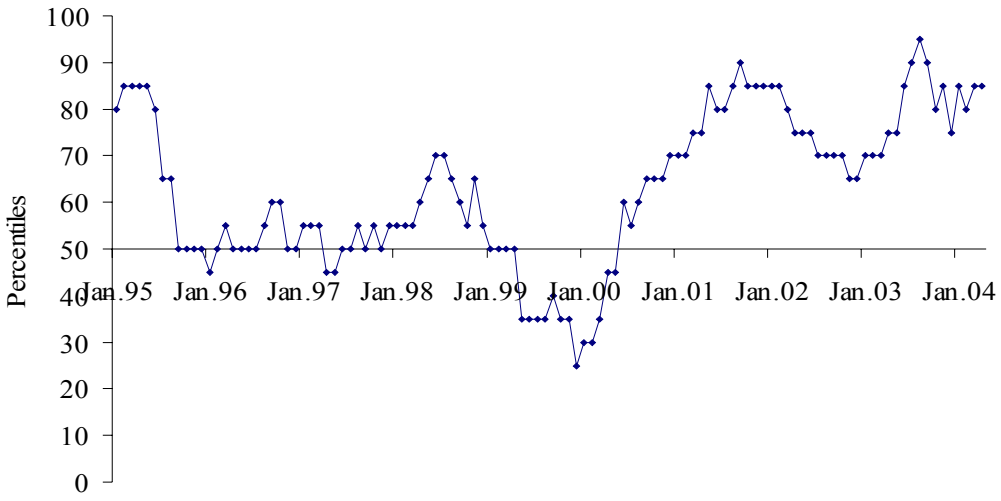


Figure 7. Sample mean percentiles: annualized monthly inflation rates, Y/Y

The annualized monthly observation of the sample mean ranges from the 25^{th} to 95^{th} percentiles, meaning that as little as *25%* or, at other times, as much as *95%* of the CPI categories experience price changes that are smaller than the recorded CPI. The median level and the mean of sample mean percentiles, which are *65* and *63* percentiles, respectively, are quite close. Therefore, the range of prices for the comparison of percentile values with the benchmark trend is chosen according to both average and median levels of sample means. Table 6 (in the Appendix) presents six better performing measures chosen by RMSE and MAD from the set of percentiles within the range *50-80*. The 55^{th} percentiles have the lowest values of RMSE and MAD for the period 1995-2000, when inflation is characterized by a highly volatile pattern, while in more stable periods, i.e., during 2001-2004, the 65^{th} percentiles correspond to the optimality criterion.

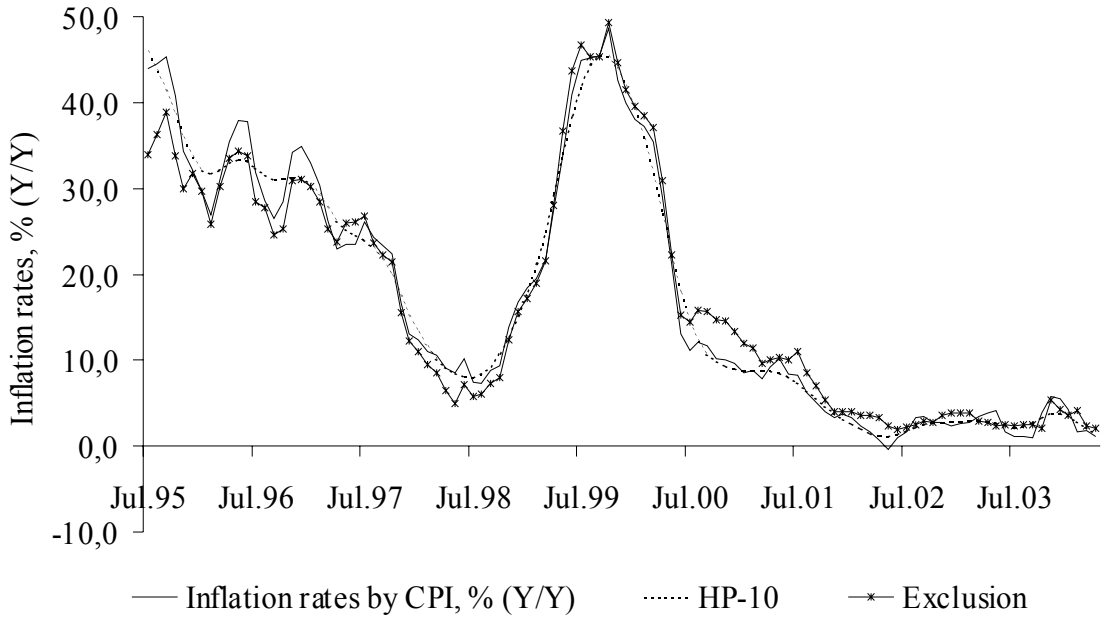
5. Finding optimal measures

As it was mentioned earlier, core inflation should satisfy the property of smoothness. To check this property, we compare derived inflation measures with the benchmark trend (e.g., HP-10) on the basis of RMSE and MAD. Table 7 (in the appendix) presents the better performing inflation estimators from the set of measures derived from each alternative method. As it is shown, eliminating extraneous price jumps/falls from the CPI that lie beyond +-*3.0* standard deviations and excluding *31* components from the basket allow one to significantly improve the inflation measure in terms of its smoothness. Two other measures, which are the 55^{th} percentile means and trimmed means obtained by censoring *1%* of observations from both tails of distributions, significantly lose in terms of efficiency. The comparison of alternative methods during the whole sample period shows, consequently, that means obtained by the exclusion method and the exclusion of unusual jumps yield better results compared to the trimmed means and percentile methods.

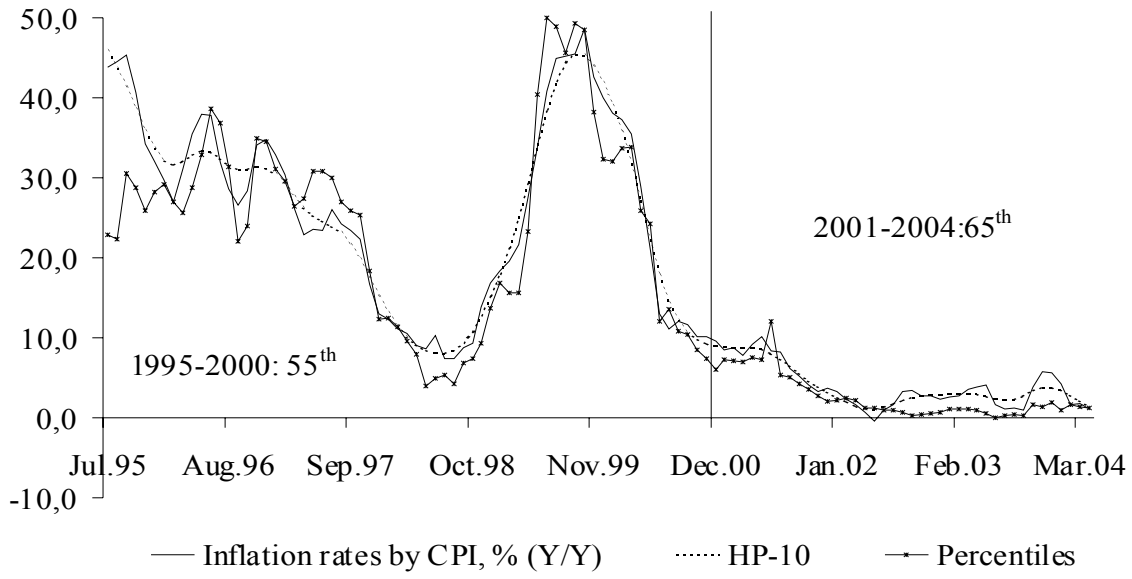
However, as it was mentioned earlier, both the exclusion and standard deviation trimmed means methods have serious drawbacks, which might limit their practical advantageousness due to the conditions of the KR. First, expenses on goods and services, which are excluded from the basket by the exclusion method, compose the largest portions of families' budget. Besides, the high share of agriculture in the economy of the KR does not allow excluding too many seasonal goods as policymakers pay great attention to the seasonal factors of the economy. A disadvantage associated with the standard deviation trimmed means method is the high probability of losing important information because prices are excluded from the CPI without knowledge of the source of price jumps or falls. If outlier prices contain information which is important in forming future price expectations, then excluding these prices is not desirable. In general, the intuitive exclusion of important components from the basket might increase the chances of losing necessary information. Thus, it can make both private and public opinion suspicious of the concept of core inflation as the long-run inflation measure.

Figure 8 shows the dynamic of smoothed inflation measures chosen by RMSE and MAD from the set of measures derived by four alternative methods.

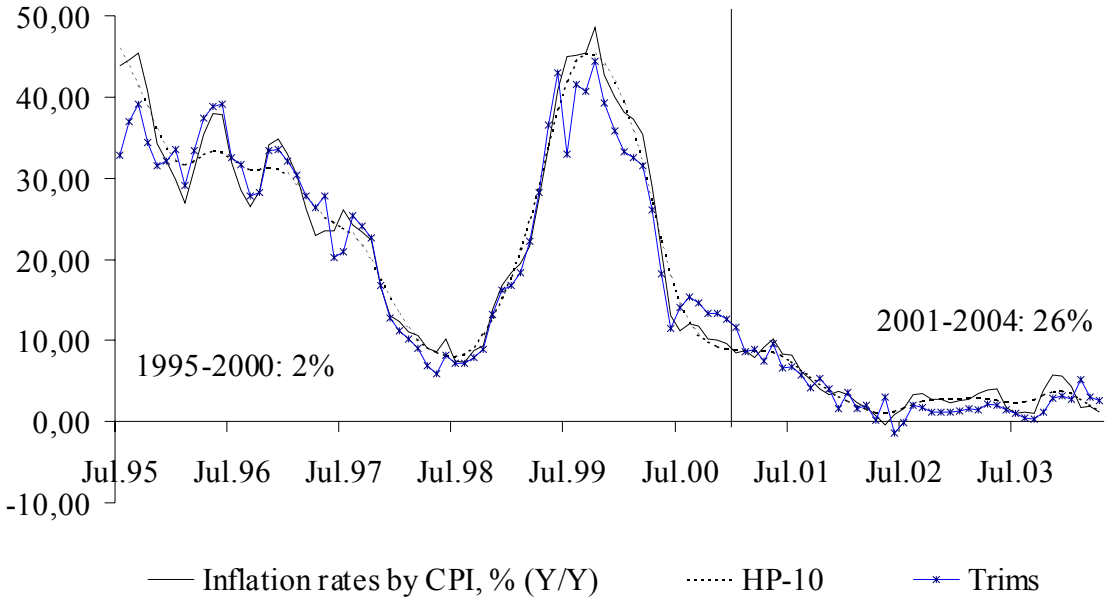
a) Exclusion



b) Percentiles



c) Trimmed means



d) Standard deviation trimmed means

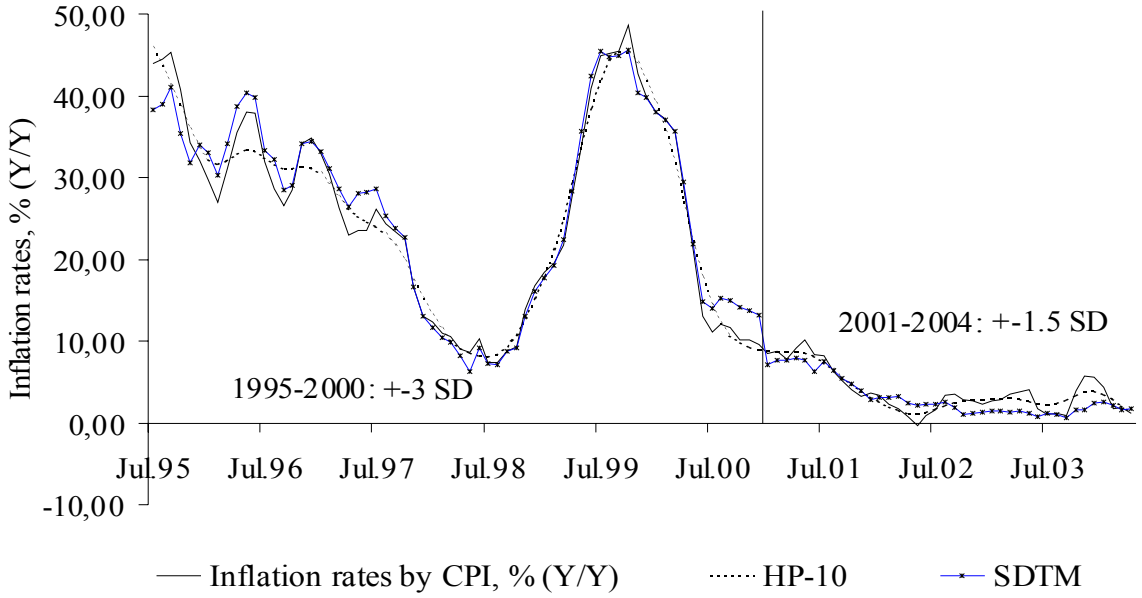


Figure 8. Core inflation estimators: a) exclusion; b) percentiles; c) trimmed means; and d) standard deviation trimmed means

As Figure 8 demonstrates, means obtained by the standard deviation trimmed means method are the best; MAD and RMSE are the lowest. The second best result is obtained by the exclusion method, at which MAD and RMSE are lower compared to the trimmed means and percentile methods. Despite the fact that the percentile method has poor results, it has an important advantage compared to the other methods. Namely, it takes into account all the available observations. Therefore, one should not reject it completely, especially, when in some periods the dynamics of aggregate price levels have large leaps relative to other periods as in the case of the KR.

As it is already mentioned, the CPI of the KR is characterized by large fluctuations from 1995 to 2000, while during 2001 to 2004 its pattern is much smoother. Taking this into account, RMSE and MAD of the derived means are compared separately for the periods July 1995 to December 2000 and January 2001 to April 2004. The analysis of the alternative methods in the environment of low inflation only shows that the 65^{th} percentiles of the CPI are the most suitable measure of core inflation (see Table 7 in the Appendix). The MAD and RMSE of these percentiles from the benchmark trend is the lowest among all alternatives estimated during 2001-2004. This indicates the fact that during periods of more stable inflation, the core inflation measure is more distanced from the median of the CPI. In more volatile periods, on the contrary, it is close to the median of the CPI. In other words, when the aggregate CPI has a steady downward trend after a large spike, the methods based on exclusion perform especially well. When the aggregate CPI is low and more diverse in its changing pattern, the percentiles and trimmed means methods are better for measuring core inflation.

6. Conclusion

The success and efficiency of monetary policy in terms of inflation stability depends on whether the inflation measure reflects long-term price movements or includes short-term shocks as well. This paper presents information on the system of inflation measurement in the KR and argues that the inflation measure based on the CPI does not correspond to the ideal inflation measure. High volatility of the CPI, which stems from its strong sensitivity to various non-monetary factors and structural (supply) shocks, significantly complicates the main goal of the central bank, to control inflation. In this

respect, this study investigates four alternative methods (e.g., exclusion, trimmed means, standard deviation trimmed means, and percentile) of measuring core inflation.

The sample covers a full set of the disaggregated CPI data for the period of 1995-2004. Inflation measures obtained on the basis of four alternative methods are examined based on the property of a long-term inflation measure – the smoothness property. This property is evaluated by minimizing the distance (RMSE and MAD) between derived inflation measures and the benchmark trend (HP-10) of the CPI. The results suggest that in periods of large declines in inflation (when all or almost all CPI components decrease steadily), the standard deviation trimmed means and exclusion means are preferable, while in periods of more diverse change across CPI items, the percentile means are robust. Since inflation was falling during most of the years included, the exclusion and the standard deviation trimmed means methods seem to yield better results for the whole period. However, these methods have a serious disadvantage because exclusion occurs at the intuitive level and the probability of losing important information is high. In this respect, four methods are compared in periods of low inflation only. It reveals that the percentile method, which takes into account all the available observations, is robust.

In general, this research is the first attempt to study and test the alternative methods of measuring core inflation on the basis of KR data. Therefore, the results of this research should not be considered a definitive answer to what is the appropriate measure of core inflation in the KR. Rather it sheds some light on the way of filtering out noises and short-term shifts in price changes in order to get a smoothed inflation measure. The results show that additional research is necessary. In particular, it is desirable to test alternative methods on the extended data with changing inflation trends. Also, a more convincing theoretical approach for separating actual time series that are highly sensitive to exogenous shocks into smooth and stationary components is necessary.

Appendix: Tables

Table 1. Basic macroeconomic indicators of the KR

Main indicator	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Inflation rate, (%, Y/Y):	2034	1366	87	32	35	13	17	39	9	4	2	6
-foods	2876	980	73	41	39	15	117	45	10	0	2	5
-non-foods	1063	940	73	13	20	6	11	30	7	1	1	2
-paid services	440	5790	509	38	42	18	23	36	16	22	4	18
GDP(%, rate)	-16	-16	-20	-5	7	10	2	4	5	5	0	7
Budget deficit (% of GDP)	-14	-7	-8	-12	-5	-5	-3	-2	-2	0.4	-1	-1
External debt (mln.US $)	4	290	446	608	764	928	1480	1699	1703	1677	1785	1966
Export (mln.US$)	824	679	568	489	562	677	601	527	573	560	629	…
Import (mln. US$)	1102	834	674	704	1034	817	955	712	652	564	685	…
Exchange rate, KGS/US$ (end of the period)	#	8	11	11	17	17	29	45	48	48	46	44

Source: NBKR, NSC, MF, WDI

Table 2. Skewness and kurtosis of CPI distributions: annualized monthly data

	Weighted		**Unweighted**	
	Skewness	Kurtosis	Skewness	Kurtosis
Mean	7.3	200.3	6.2	78.0
Median	3.1	22.8	3.9	30.9
Standard deviation	9.7	370.9	5.1	91.7

Sources: NSC, calculations of the author

Table 3. Standard deviations (SD) of prices during July 1995 to April 2004

		SD	Weights								
			1995	1996	1997	1998	1999	2000	2001	2002	2003
#	Excluded items:		0.0489	0.0492	0.0455	0.0503	0.0533	0.0554	0.0585	0.0766	0.0766
1	Cologne	905	0.0004	0.0004	0.0004	0.0004	0.0006	0.0007	0.0008	0.0027	0.0027
2	Garlic	486	0.0002	0.0003	0.0002	0.0003	0.0007	0.0005	0.0008	0.0011	0.0011
3	Notary services	481	0.0005	0.0012	0.0013	0.0013	0.0006	0.0006	0.0006	0.0009	0.0009
4	Lipstick	333	0.0004	0.0004	0.0004	0.0004	0.0006	0.0007	0.0008	0.0025	0.0025
5	Rent per sq.m	303	0.0017	0.0017	0.0019	0.0019	0.0026	0.0029	0.0021	0.0025	0.0025
6	Onion	107	0.0065	0.0062	0.0047	0.0066	0.0058	0.0059	0.0081	0.0050	0.0050
7	Pear	106	0.0007	0.0006	0.0005	0.0006	0.0005	0.0005	0.0004	0.0004	0.0004
8	Grapes	97.6	0.0013	0.0010	0.0009	0.0006	0.0007	0.0009	0.0009	0.0009	0.0009
9	Shoes repair	94.6	0.0014	0.0014	0.0015	0.0015	0.0012	0.0012	0.0012	0.0011	0.0011
10	Spring onion	72.9	0.0003	0.0003	0.0002	0.0003	0.0003	0.0003	0.0004	0.0003	0.0003
11	Postal service	69.5	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0024	0.0024
12	Slippers	68.7	0.0004	0.0004	0.0005	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002
13	Fresh cabbage	68.3	0.0022	0.0025	0.0020	0.0022	0.0021	0.0019	0.0019	0.0018	0.0018
14	Cherry	67.9	0.0007	0.0006	0.0005	0.0006	0.0005	0.0006	0.0005	0.0005	0.0005
15	Water	67.7	0.0074	0.0075	0.0083	0.0085	0.0081	0.0111	0.0135	0.0263	0.0263
16	Tumip	65.7	0.0014	0.0016	0.0014	0.0015	0.0015	0.0013	0.0013	0.0014	0.0014
17	Beetroot	65.6	0.0014	0.0017	0.0013	0.0014	0.0013	0.0014	0.0015	0.0013	0.0013
18	Detergent	64.3	0.0040	0.0038	0.0040	0.0040	0.0064	0.0062	0.0061	0.0057	0.0057
19	Envelopes	55.0	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0007	0.0007
20	Nuts	53.2	0.0017	0.0015	0.0009	0.0016	0.0017	0.0012	0.0011	0.0012	0.0012
21	Paint	52.7	0.0005	0.0006	0.0007	0.0007	0.0018	0.0014	0.0014	0.0020	0.0020
22	Apple	50.7	0.0041	0.0035	0.0031	0.0036	0.0030	0.0029	0.0025	0.0025	0.0025
23	Telegraph	50.3	0.0006	0.0005	0.0005	0.0005	0.0004	0.0004	0.0003	0.0001	0.0001
24	Lemon	49.8	0.0009	0.0009	0.0007	0.0008	0.0011	0.0010	0.0009	0.0011	0.0011
25	Apricot	48.7	0.0014	0.0012	0.0010	0.0012	0.0010	0.0006	0.0006	0.0006	0.0006
26	Aubergine	47.9	0.0007	0.0008	0.0007	0.0008	0.0008	0.0007	0.0007	0.0008	0.0008
27	Carrot	47.8	0.0042	0.0052	0.0039	0.0041	0.0038	0.0041	0.0045	0.0040	0.0040
28	Pumpkin	47.5	0.0001	0.0001	0.0001	0.0001	0.0003	0.0002	0.0001	0.0001	0.0001
29	Strawberry	46.3	0.0016	0.0011	0.0013	0.0016	0.0016	0.0012	0.0012	0.0015	0.0015
30	Cement	46.1	0.0012	0.0015	0.0016	0.0016	0.0032	0.0038	0.0032	0.0044	0.0044
31	Theater tickets	45.8	0.0003	0.0002	0.0003	0.0003	0.0002	0.0002	0.0001	0.0008	0.0008

Sources: NSC KR, NBKR

Table 4. Trimmed means after 2-side censoring of price distributions

The whole sample period				January 1995 to December 2000				January 2001 to April 2004			
Trims %	RMSE	Trims %	MAD	Trims %	RMSE	Trims %	MAD	Trims %	RMSE	Trims %	MAD
2	3.1	2	2.4	2	3.5	2	2.8	26	1.9	26	1.5
4	4.3	4	2.8	4	5.1	4	3.4	34	2.0	34	1.7
6	5.1	6	3.3	6	6.1	6	4.3	32	2.1	32	1.7
28	5.5	28	3.8	28	6.7	12	4.9	8	2.1	8	1.7
8	5.7	8	3.8	14	7.1	8	5.0	10	2.1	10	1.7
16	5.8	16	4.0	8	7.1	28	5.1	4	2.2	4	1.7

Sources: NSC KR, calculations of the author

Table 5. Standard deviation trimmed means

The whole sample period				January 1995 to December 2000				January 2001 to April 2004			
Cut-of points	RMSE	Cut-of points	MAD	Cut-of points	RMSE	Cut-of points	MAD	Cut-of points	RMSE	Cut-of points	MAD
+-3.0	2.5	+-3.0	1.9	+-3.0	2.9	+-3.0	2.3	+-1.5	1.3	+-1.5	1.1
+-2.5	2.9	+-2.5	2.2	+-2.5	3.4	+-2.5	2.7	+-1.0	1.6	+-1.0	1.4
+-2.0	3.4	+-2.0	2.5	+-2.0	4.1	+-2.0	3.2	+-3.0	1.7	+-3.0	1.2
+-1.5	7.8	+-1.5	5.2	+-1.5	9.9	+-1.5	7.6	+-2.0	1.8	+-2.0	1.5
+-1.0	10.6	+-1.0	7.3	+-1.0	13.4	+-1.0	10.8	+-2.5	1.8	+-2.0	1.5

Sources: NSC KR, calculations of the author

Table 6. Percentile means

The whole sample period				July 1995 to December 2000				January 2001 to April 2004			
Percen-tiles	RMSE	Percen-tiles	MAD	Percen-tiles	RMSE	Percen-tiles	MAD	Percen-tiles	RMSE	Percen-tiles	MAD
55	4.9	55	2.8	55	6.2	55	4.5	65	1.1	65	0.9
60	4.9	60	2.8	60	6.2	60	4.5	60	1.3	60	1.2
50	5.9	50	3.5	50	7.4	50	5.7	55	1.8	70	1.4
65	6.1	65	3.8	65	7.8	65	6.2	70	1.8	55	1.6
70	9.9	70	6.4	70	12.6	70	10.3	50	2.3	50	2.1
75	13.4	75	9.2	75	17.0	75	14.8	80	5.5	75	4.5
80	17.6	80	12.6	80	22.2	80	20.2	75	8.2	80	4.9

Sources: NSC KR, calculations of the author

Table 7. Inflation estimators and the property of smoothness

	The whole sample period			July 1995 to December 2000			January 2001 to April 2004		
		RMSE	MAD		RMSE	MAD		RMSE	MAD
Exclusion		2.9	2.0		3.4	2.6		1.3	1.1
Sample means percentile	55	4.9	2.8	55	6.2	4.5	65	1.1	0.9
Standard deviation trimmed means	+-3.0	2.5	1.9	+-3.0	2.9	2.3	+-1.5	2.8	2.3
Trimmed means	2%	3.1	2.4	2%	3.5	2.8	26%	1.9	1.5

Source: NSC, the calculation of the author

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