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Financial Policies and Dynamic Game Simulation in Poland and Hungary

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Abstract

Recently, steady economic growth rates have been kept in Poland and Hungary. Money supplies are growing rather rapidly in these economies. In large, exchange rates have trends of depreciation. Then, exports and prices show the steady growth rates. It can be thought that per capita GDPs are in the same level and development stages are similar in these two countries. It is assumed that these two economies have the same export market and export goods are competing in it. If one country has an expansion of monetary policy, price increase and interest rate decrease. Then, exchange rate decrease. Exports and GDP will increase through this phenomenon. At the same time, this expanded monetary policy affects another country through the trade. This mutual relationship between two countries can be expressed by the Nash-equilibrium in the Game theory. In this paper, macro-econometric models of Polish and Hungarian economies are built and the Nash- equilibrium is introduced into them.

Keywords: Nash-equilibrium, Game theory, Macro-econometric model, Trade, Simulation, Reaction function, Money supply, Central bank

JEL classification: C73, E17, F42

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Financial Policies and Dynamic Game Simulation in Poland and Hungary

Hisao Yoshino

Introduction

Polish economy maintained around 5 % GDP growth rate from 1995 to 2000. The investment, export and imports showed rapid growth rates. Then, the trade deficit increased and the exchange rate kept the trend of depreciation. In this period, the growth rate of M2 showed large figures. On its peak, it was larger than 30%. In 2001, GDP growth rate became less than 2 %. The investment started to have the trend of decrease and the growth of export declined. The trade deficit started to decrease a little. The exchange rate had a trend of appreciation. The growth rate of M2 showed negative value in 2002 and one digit value in 2003. However, the growth rate of M2 recovered in 2004 and showed 2 digits value in 2005. The investment started to recover also in 2004. Then, the exchange rate started to decrease in 2004.

Hungarian economy had small GDP growth rates, less than 2%, in 1995 and 1996, showing depression. However, after this period until 2000, it kept rather high growth rates around 5%. The investment, export and imports showed steady growth rates. Then, the trade balance always showed deficits. The exchange rate kept the 2 digits depreciation rates. In this period, the growth rate of M2 always showed 2 digits figures. In 1998, it was more than 30%. After 2001, it kept this trend, showing around 5 % growth rates of GDP. The trade balance always showed deficits because of steady growths of investment, export, and imports. The exchange rate continued to appreciate, but depreciated in other years. The growth rate of M2 always showed figures larger than 10% except for 9% in 2004. It can be observed that the Hungarian central bank have a more active attitude compared with the Polish central bank. It is assumed that these 2 countries have the same export market and they are competing in that market. If the one country has an expansionary fiscal policy, the price increase and the interest rate decrease. Then, the exchange rate depreciates. These changes increase the export and GDP. However, such policy affect the another economy through the trade. This mutual relationship of two countries can be expressed by the Nash equilibrium of the Game theory. In this paper, the macro econometric models of Poland and Hungary have been built at first, then, the Nash equilibrium have been introduced.

In the next section, outlooks of Polish and Hungarian economies are explained. Financial polices of these countries are explained in the section 2. Then, in the section 3, the macro

econometric models and simulation are explained.

Section 1・Outlooks of Macro Economies

Polish economy experienced the negative GDP growth rate in 1990 and 1991 consecutively since the start of liberalization (Figure 1). In this period, the price showed extraordinary high growth rate. Even in the middle of 1990's, the price still showed the 2 digits growth rate (Figure 2) and the GDP growth rate showed rather small figures less than 5%. The unstable economic situation was kept. When we look at the movement of Money supply M2 (Figure 3), we understand that the growth rate has been over 30% until 1996. The gross investment showed 15% of the growth rate in 1990, but it dropped to minus 20% in 1991. After that, it continued to increase up to 20% in 1997. The growth rate of household consumption recorded large negative value in 1990. But, it was the exceptional case. In large, it recorded around 5%, showing the bottom of 1 or 2 % growth rate in 1994 and 1995. In Poland, the will to consume was strong traditionally. In this period, the purchase of family cars was very active and it became the one of driving factors to support the economic growth. The growth rate of export showed the large figures more than 10% in large, except for 0% in 1991 and 4% in 1993.・During this time, trade partners shifted from the post socialist countries to the western countries. The growth rate of exchange rate (Figure 4) recorded around 10% depreciation consecutively until 1996 except for the large depreciation in 1991. This phenomena brought the large increase of export and steady GDP growth rate. But, it brought the rapid increase of the price, at the same time. To keep the steady growth rate of GDP, they conducted policies to change trade partners and convert the industrial structure from the heavy industry to the industry which reflect the comparative advantages. However, in the beginning of 1990's, the economic situation was still unstable. Reflecting the instability and inactiveness of economy, the share of trade balance in GDP (Figure 5) was always small from 4% in 1990 to 1.4% in 1995. The driving force of Polish economy was the foreign direct investment (Figure 6). However, that value was still small before 1995. It doubled from 1994 to 1995. But it was still less than 4 billion US dollars. It could be pointed out that the scale of the foreign direct investment was rather small, compared with the figures after 1995 or Hungarian case.

After 1995, the economic situation started to have stability. The GDP growth rate maintained the very steady figures around 5% from 1995 to 2000. The growth rate of price shown by GDP deflator decreased from 40% in 1995 to less than 20% in 1996. It showed the calmness of the economy. The growth rate of GDP deflator decreased monotonously from 1996 to 0% in 2003 in large. The movement of money supply M2 had a similarity. The growth rate of M2 decreased from 35% in 1995 to the negative figure in 2002, monotonously. The gross investment showed the large

increase of 18% in 1996, then it increased, furthermore, 21% in 1997. Until 1999, the large increase more than 10% was kept. The growth rate of household consumption was always on the high level from 8.5% in 1996 to 9.4% in 1999. In this period, the boom of the family cars was maintained. The increase of export was kept from 21% in 1995 to 9.5% in 1999. It is the result of rapid increases of foreign direct investment and automobile export to EU in this period. The exchange rate started to show the trend of appreciation. Both of export and imports showed the trend of increase. The share of trade balance in GDP showed minus 1.4% in 1996. It was the first negative value since the start of reform.

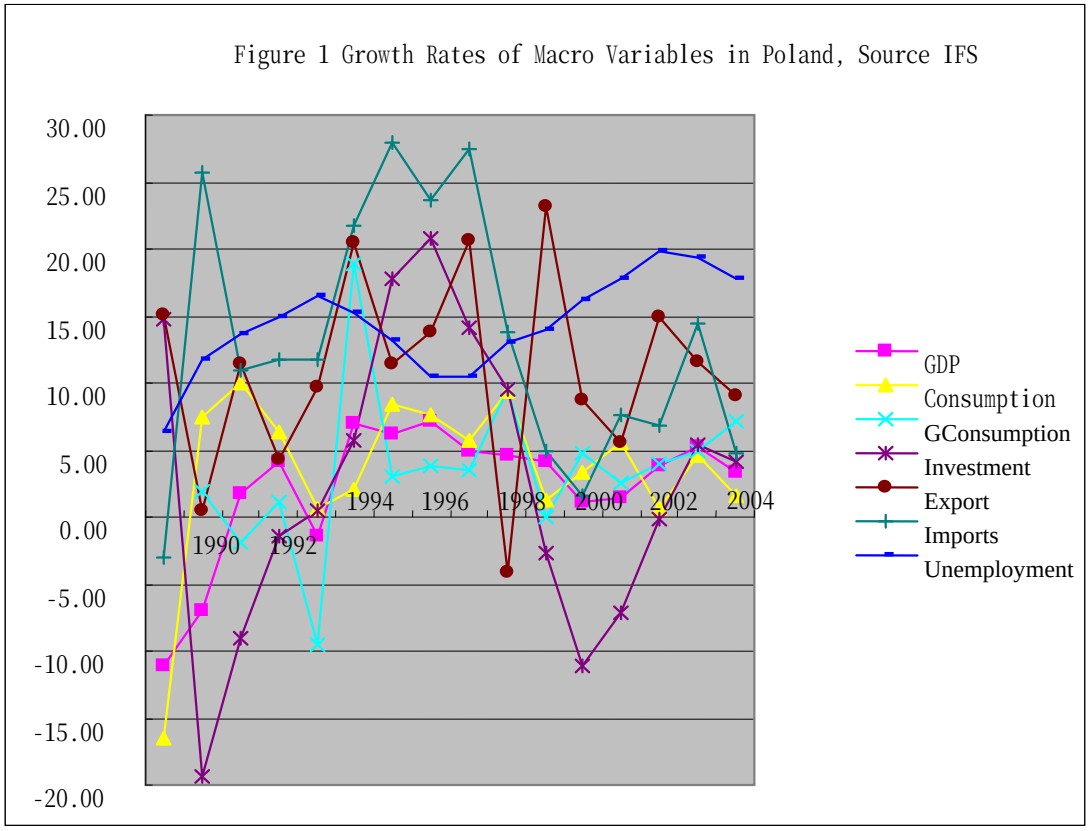


Figure 2 Growth Rate of GDP deflator in Poland (Source IFS)

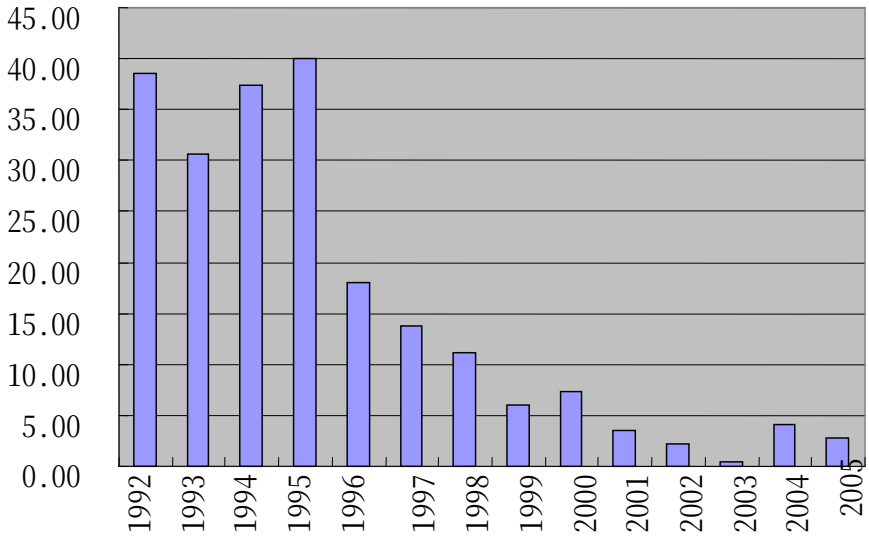


Figure 3 Growth rate of M2 in Poland (% Source IFS)

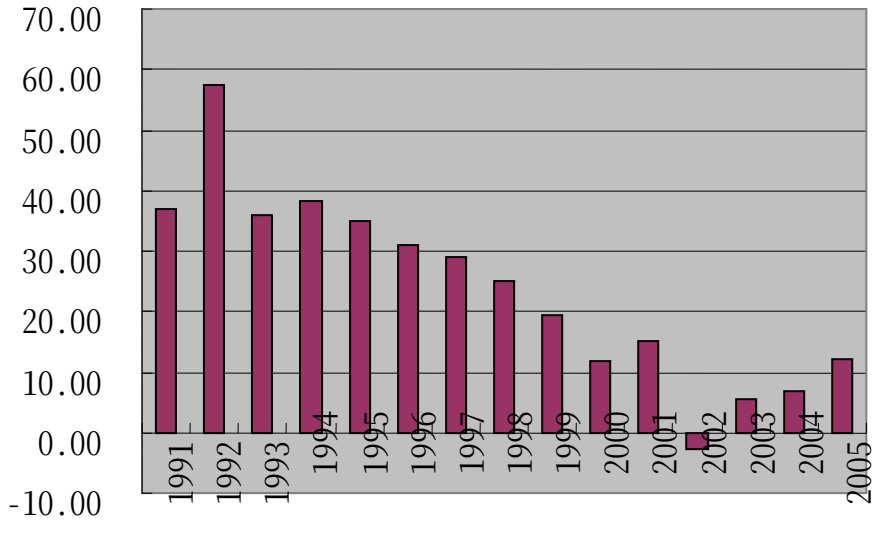


Figure 4 Growth Rate of exchange rate in Poland, Source IFS

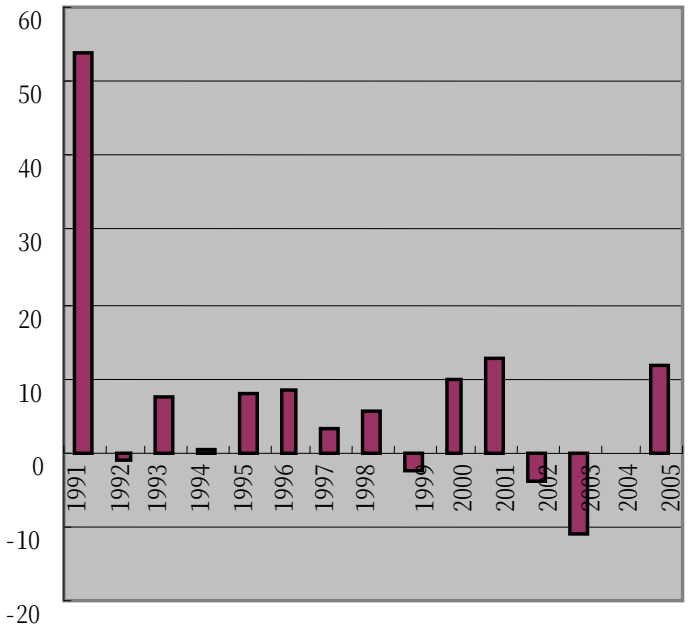


Figure 5 Share of Trade Balance in GDP for Poland (%、Source IFS)

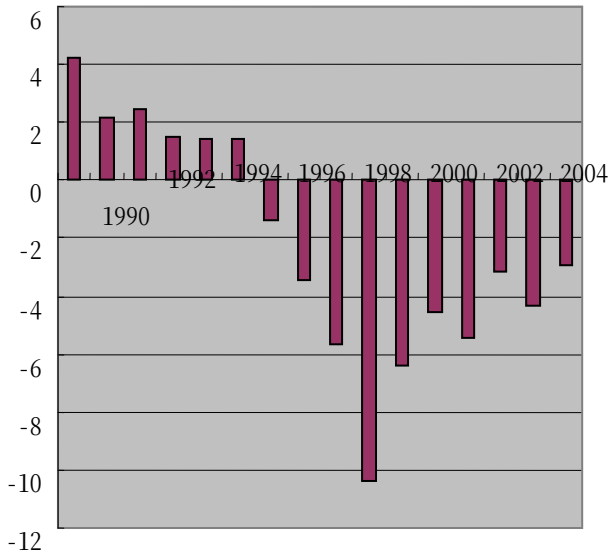


Figure 6 FDI for Poland (Million US Dollars Source IFS)

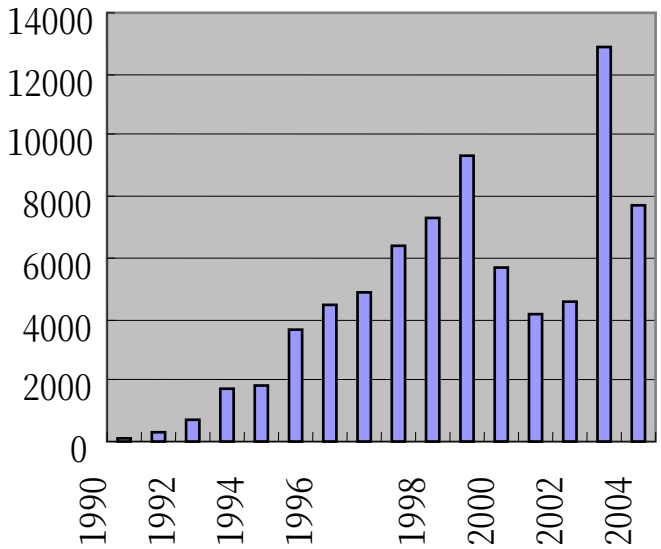
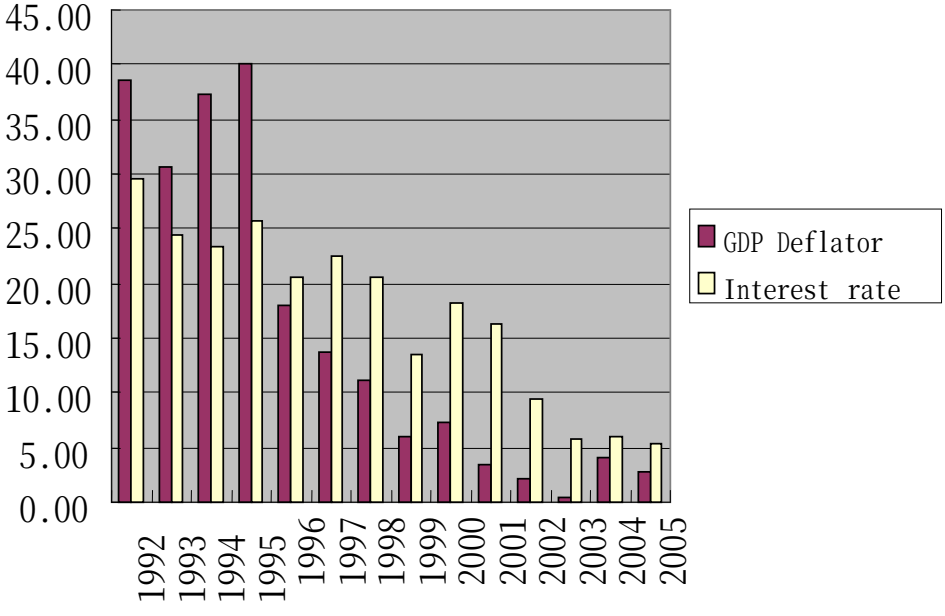


Figure 7 GDP Deflator and Interest Rate in Poland, Source IFS



Since this year, this negative value continued to be enlarged until minus 10% in 1999 reflecting the steady GDP growth rate. The foreign direct investment increased rapidly in this period. FDI in 1995 recorded 3.7 billion US dollars which was doubled compared with 1994, then it continued to increased to 9.3 billion US dollars in 2000. According to the favorable increase of foreign direct investment, the economy continued to have the steady GDP growth rate around 5% , showing rapid increase of imports, in this period. Until 1998 the export continued to increase by 10% or 20%. But, in 1999, the export suddenly decreased by 4%. At the same time, exchange rate showed the appreciation by 2.5%. GDP growth rate was 4.6% which was slightly less than the year before. The interest rate (Figure 7) decreased to 13.6% in 1999 largely. Before 1999, it was larger than 20%. This decrease of interest rate did not become the factor to depreciate the exchange rate. Then, the unemployment rate continued to decrease until 10.4% in1998, but it started to have the trend of increase from 1999. Except for some small movements, this economy was in the favorable situation until 2000.

After the year of 2000, it could be found some changes in Polish economy. The growth rate of GDP decreased from 4.2% in 2000 to 1.1% in 2001 and it remained in the law level of 1.4% in 2002. The growth rate of price shown by GDP deflator recorded 3.5% in 2001, 0.4% in 2003. Then, since that time it remained in the level of around 5%. The growth rate of money supply M2 showed the decrease from 19% in 1999 to 12% in 2000. In 2001, it increased to 15%, but, decreased by 3% in 2002. After that, the growth rate of M2 continued to increase as 6%, 7%, and 12%. The growth rate of gross investment continued to have negative values from minus 3% in 2000 to the year of 2003. This trend is opposite to the trend until 1997. The foreign direct investment continued to increase until 9.3 billion US dollars in 2000, however, it decreased largely after that. It was 5.7 billion US dollars in 2001 and 4.1 billion US dollars in 2002. After that, it increased slightly to 4.6 billion US dollars and increased largely to 12.9 billion US dollars in 2004. After the year of 2000, the growth rate of household consumption remained less than 5%. Compared with years before 2000, it showed calmness. The export decreased by 4% in 1999 and increased largely by 23% in 2000. But, after that, its growth rate was less than 15%. The exchange rate appreciated from 2002 to 2004. Especially, it appreciated more than 10% in 2003. The share of trade balance in GDP continued to have figures of around minus 5% after minus 6.4% in 2000. In 2005, it recorded minus 2.9%, then the share of trade deficit slightly decreased. In spite of the steady condition of economy, the unemployment rate continued to increase from 1999 to 2003. In 2003, it reached to 20%. But, after that, it started to decrease and it recorded 18% in 2005. If we observe this economy since 2003, we can find some trends such as the trend of increase in the growth rate of M2, the trend of acceleration of the growth rate of GDP deflator, the trend of decrease in the interest rate, the trend of increase in the growth rate of GDP, the trend of depreciation in exchange rate, and the trend of increase in

export.

In 1960's, many reforms were conducted in the former Soviet Union and countries in East European countries. However, only Hungarian reform called "New Economic Mechanism: NEM" remained in effectiveness. It lead to the economic liberalization in the latter half of 1980's. In the beginning of 1980's, they had already established the system of private contract of the small scale state enterprise, and the system of corporate bond. They started to try to reform the labor market and introduce a capital market. In 1986, they established the law of bankruptcy and introduced the unemployment insurance. After that, until the privatization of state enterprise and the price liberalization in 1989, various reforms were conducted. The start of reforms in Hungarian economy was much earlier than Polish economy. Therefore they could control more adequately fluctuations accompanied with reforms compare with Polish case. .

The GDP growth rate of Hungarian economy (Figure8) recorded minus 3% in 1992. After this year, this economy started to have a trend of recover gradually. From 1994, this economy never experienced the negative GDP growth rate. The growth rate of price shown by GDP deflator (Figure 9) recorded the largest figure of 35% and then it started to decrease. It decreased to 19% in 1994. In 1995, it increased to 27% again. But, after that, it had a trend of decrease. The growth rate of money supply M2 (Figure 10) showed close to 30% in 1990 and 19991. Then, it decreased to 13% in 1994. After that it had a trend of increase again. The growth rate of gross investment continued to show negative value until minus 6% in 1993. Then, it had a trend of recover, showing 10% in 1994. The private consumption increased by 4% in 1991 and 1% in 1992. In 1995, it decreased by 6% in 1995. The growth rate of export showed positive value, 3.5% in 1992. It decreased to minus 10% in 1993. However, after that, it showed figures a little bit more than 10% in large, except for the large value of 14% in 1994. The exchange rate (Figure 11) depreciated largely, by 35% in 1991 and 29% in 1993. In general, until 1995, it depreciated by around 15% in other years. Hungarian exchange rate continued to depreciate until 2001. It had a contrast with the Polish case in which the exchange rate had a trend of appreciation earlier. The growth rate of money supply M2 decreased from 30% in 1991 to 13% in 1994. The growth rate of GDP deflator decreased from 35% in 1991 to 19% in 1994, also. The movement of exchange rate had a similarity with them. The share of trade balance in GDP (Figure 12) was around minus 2% in 1991 and 1992, then it decreased a lot to minus 8% in 1993. It had a similar figure in 1994 also. This seemed to have a relationship with the very large depreciation of exchange rate by 29% in 1993. After the reform, the foreign direct investment (Figure 13) was the driving force of this economy. But, its role was smaller until 1994. FDI recorded around 1.5 billion US dollars in 1991 and 1992. In 1993, it increased to 2.4 billion US dollars, then, it decreased to 1.1 billion US dollars in 1994.

In 1994, GDP growth rate showed 3%. At last, this economy could escape from the negative growth. But, it showed still low level, 1.4% in 1995 and 1.3% in 1996. In 1997, it increased

to 4.6%. Then, it kept the same level. The growth rate of GDP deflator recorded large figures, 27% in 1995 and 21% in 1996. After that, it had a trend of decrease, 18% in 1997 and 13% in 1998. The growth rate of M2 increased from 18% in 1995 to 21% in 1996, then, it reached to30% in1998. After that, it ha a trend of decrease, and it showed 13% in 2000. The growth rate of gross investment was 2% in 1995 and recovered to 7% in 1996. It was steady until 13% in 1998. But, it decreased to 4% in 1999. The growth rate of private consumption continued to have negative values, minus 6% in 1995 and minus 3% in 1996, but it had favorable values, 2% in 1997, 7% in 1998, and 6% in 1999, according to the rather high GDP growth rate in this period. The growth rate of export started to increase rapidly from 1994 and it showed 48% in 1995. Until 22% in 2000, it kept to show around 20%. It can be understood that this economy was driven by the export. The exchange rate kept the trend of depreciation from 13% in 1994 to 20% in 2000. The share of trade balance in GDP was minus 7% in 1994, then, it improved to minus 2% in 1995. In 1997 it was minus 1%. But it decreased to minus 4% 1998. After that, it kept figures of around minus 4%. The foreign direct investment was 1.1 billion US dollars in 1994 and increased largely to 4.8 billion US dollars. After that, it decreased gradually to 2.8 billion US dollars in 2000. The interest rate (Figure 14), also, decreased monotonously from 33% in 1995 to 13% in 2000. However, this movement was a little more sluggish compared with the decrease of the growth rate of GDP deflator. In this period, M2 had a trend of increase and the exchange rate had a trend of depreciation. The export increased and imports increased at the same time. Then, the trade deficit expanded and it stimulated the GDP growth. As the result, GDP growth rate kept the steady figures around 5%.

The GDP growth rate recorded 5.2% in 2000 and decreased a little to 3.8% in 2001. It decreased until 2.9% in 2003. But, It kept steady figures of around 5% such as 6.8% in 2004 and 4.6% in 2005. The growth rate of GDP deflator decreased gradually from 9.9% in 2000 to 6.9% in 2003. It was 3.5% in 2004, and decreased furthermore, to 2.5% in 2005. The growth rate of M2 was around 15% from 13% in 2000 to 12% in 2003. It decreased to 9% in 2004 and recovered to 13% in 2005. The growth rate of gross investment increased from 1.7% in 2000 to 3.9% in 2002. In 2003, it showed the negative value, minus 1%. But, it recovered to 6.4% in the next year and 5% in 2005. The growth rate of private consumption increased from 2.5% in 2000 to 7.2% in 2002, and then, decreased gradually to 2.4% in 2005. The growth rate of export showed the large value, 22% in 2000. However, after that, it kept 1 digit figures until 2003. From 2004, it kept 2 digits figures. The exchange rate depreciated by 20% in 2000 and depreciated by 9% in 2001. It appreciated by 0.4% in 2002 and appreciated largely by 11% in 2003. It started to have the trend of appreciation. The share of trade balance in GDP was minus 4% in 2000. In the next year, it increased to minus 1.4%. It was minus 3% in 2002, minus 5.6% in 2003, and minus 0.1% in 2005. In large, it was around minus 5%. The foreign direct investment decreased to 2.8 billion in 2000 from 1999. In 2001, it increased to 3.9 billion US dollars. After that, it increased continuously to 6.4 billion US dollars in 2005. The interest

rate had a trend of slight decrease. In this period, the investment and GDP growth rate showed steady figures according to the increase of the foreign direct investment. In spite of the large growth rate of M2, the growth rate of GDP deflator remained in the level of 1 digit figures. It could be observed the trend of appreciation in exchange rate. In spite of the trend of appreciation in exchange rate, the export increased steadily and the share of trade deficit in GDP was larger than minus 5% in large.

Figure 8 Growth Rates of Macro Variables in Hungary, Source IFS

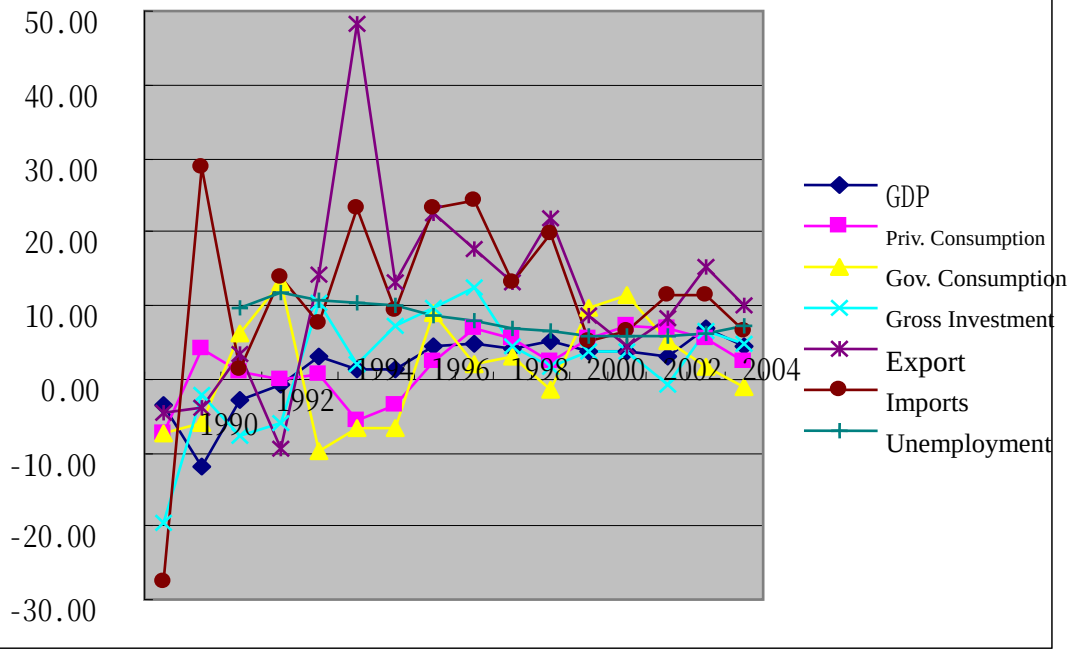


Figure 9 Growth Rate of GDP Deflator in Hungary, Source IFS

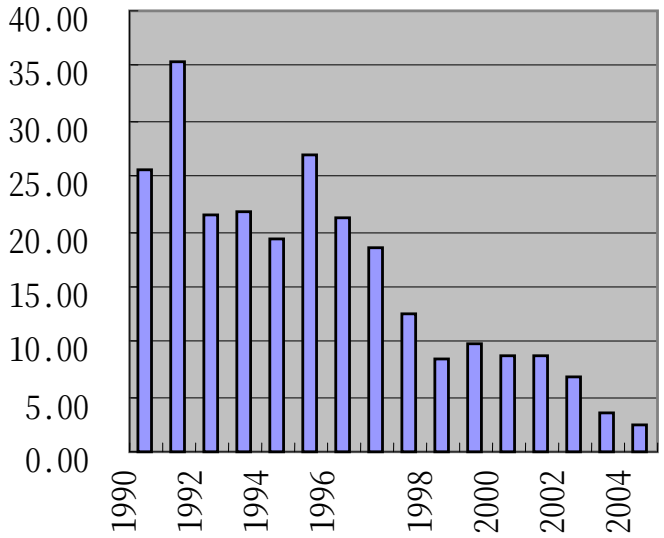


Figure 10 Growth Rate of M2 in Hungary, Source IFS

Figure 11Growth Rate of Exchange Rate in Hungary

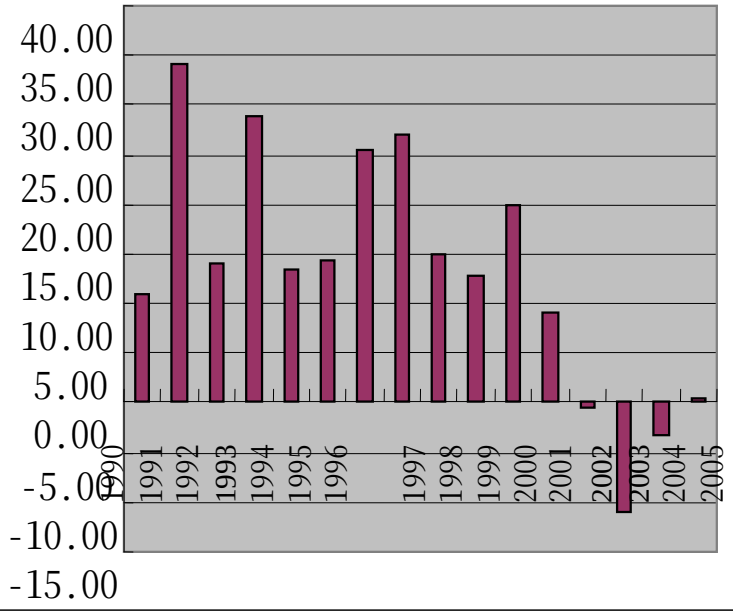


Figure12Share of Trade Balance in GDP in Hungary

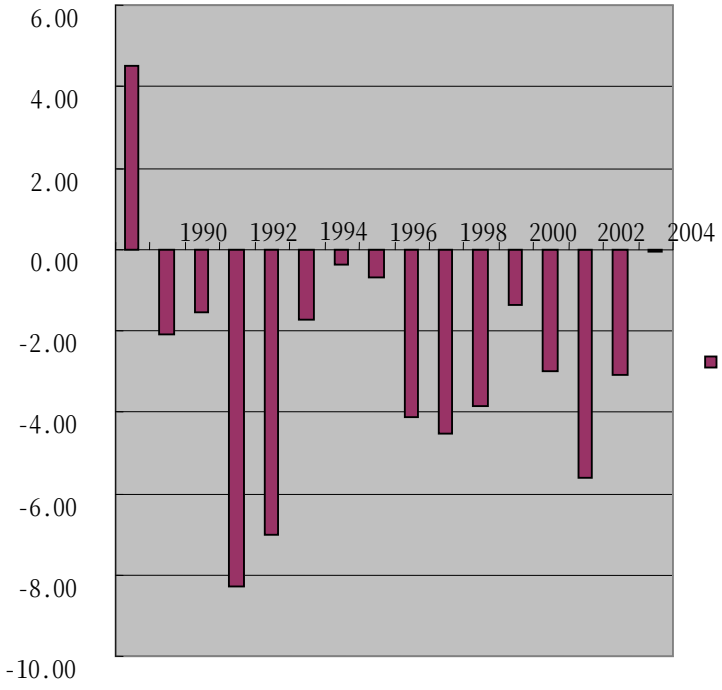


Figure13 FDI to Poland in Million US Dollars, Source IFS

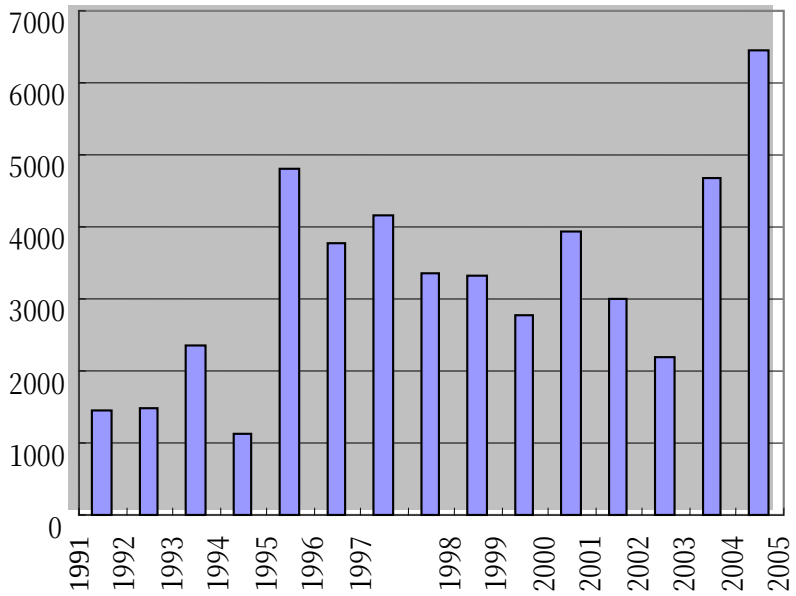
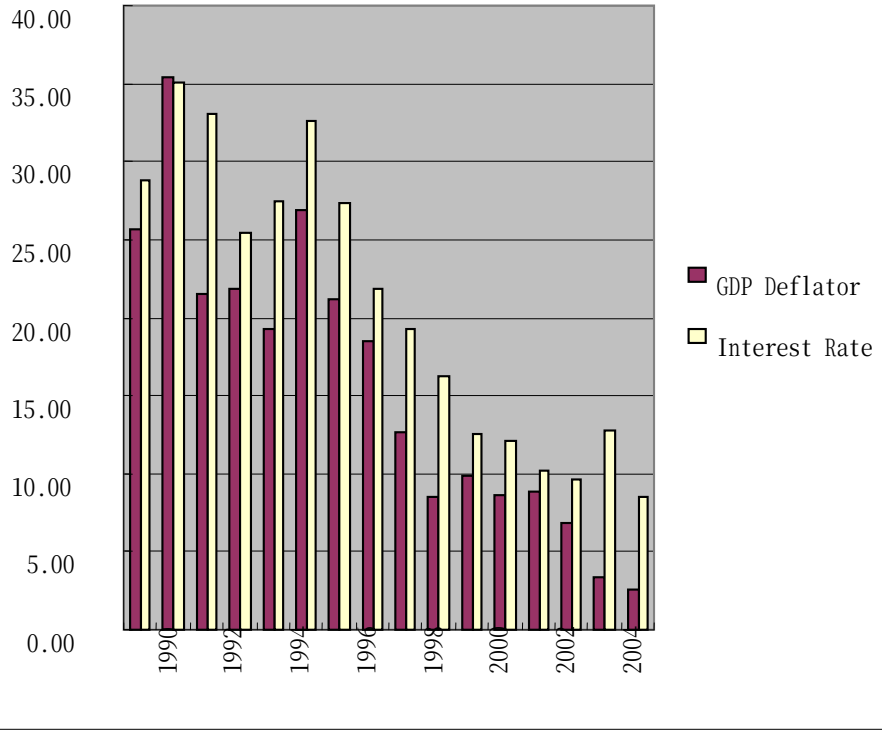


Figure 14 Growth Rates of GDP Deflator and Interest Rate in Hungary, Source IFS



Section 2 Financial Policies in Poland and Hungary

In May of 2004, Poland and Hungary joined the European Union. By this measure, trade circumstances of these countries were improved largely. Then, the prospects of export lead growth of these countries became very clear. In this period, economists in these countries discussed often the introduction of common currency, EURO. However, from around 2005, economists became not to talk about this issue.

If they adopt EURO, they can avoid the risk accompanied with the fluctuation of exchange rate. In this point of view, the investment and export could become more active. But it would become difficult to alleviate shocks in short terms and in specific areas. Then, the equilibrium exchange rate appreciates according to the promotion of economic development. If they adopted EURO, economies may start to have accelerations of inflations. Conditions of join into EURO were regulated by Maastricht Treaty. They were related to the inflation rate, the long term interest rate, the financial deficit, and the stability of exchange rate. If they have policies of monetary expansions, as a result, they could have increases of inflations, decreases of interest rates, decreases of exchange rates, large increases of exports, and accelerations of GDP growth rates. But, if they follow the treaty, they could not to have policies of monetary expansions.

The growth rate of M2 in Poland was always larger than 20% until 1998. In 1999, it became 19% and then, it continued to decrease in large to minus 2.7% in 2002. The growth rate of was GDP deflator was 11% in 1998 and it was 2.2% in 2002. From 1998 to 2002, it decreased gradually, which was similar to the movement of the growth rate of M2. The exchange rate was depreciated by 5.7% in 1998 and appreciated by 2.5% in 1999. Then, it depreciated by around 10% for 2 years. From 1998 to 2001, it showed the trend of depreciation. The demand factors analysis (Table 1) shows that the export supported 5.2% for GDP growth rate, 4.9%. In 2000, it supported 6.3% for GDP growth rate, 4.2%. From 1998 to 2001, GDP growth rate depended on the growth rate of export. But, the situation changed from 2002. In this year, the growth rate of M2 became minus 2.8% and the growth rate of GDP deflator decreased to 2.2%. The exchange rate appreciated by 4% and the contribution of export decreased to 1.7% in GDP growth rate, 1.4%. From 2003, The growth rate of money supply started to increase, again. It increased monotonously to 12% in 2005. The growth rate of GDP deflator showed around 4%. The exchanger rate depreciated by 11% in 2003 and depreciated by 12% in 2005. In this period, the growth rate of GDP was around 4% on average and the export contributed by around 4% on average. Among the demand factors, it showed the largest contribution and this meant the situation of export lead growth.

On the other hand, the growth rate of M2 had the peak of 30% in 1998, and after that, it continued to show 15%. The growth rate of GDP deflator, also, had the peak of 12.6% in 1998, and

after that, it continued to have around 8% until 2003. The exchange rate had a trend of large depreciation continuously until the 9% depreciation in 2001. However, from 2002, it showed the trend of appreciation. In 1998, GDP growth rate was 4.9% and the export contributed (Table 2) by 10.4%. Then, GDP growth rate was 5.2% and the export contributed by 16%. The export in Hungary had more important role in economic growth compared with the case in Poland. In 2003 and 2004, the growth rate of M2 decreased a little, 12.5% in 2003 and 8.9% in 2004. Then, the exchange rate appreciated by 11% in 2003 and 3% in 2004. In 2003, GDP growth rate recorded the lowest figure, 2.9% since 1997 and the contribution of export was 6.8%. In 2004, the exchange rate appreciated by 3.3%. The appreciation was smaller compared with the before. GDP growth rate was 6.8% in 2004. In 2005, the growth rate of M2 increased rapidly to 13.3% and the exchange rate depreciated. It had been 4 years since the last depreciation. In 2005, GDP growth rate was 4.6% and the contribution of export was 9.5%.

As mentioned above, it seemed like that their economies had trends as follows. Central banks increased the money supplies M2s, and the exchange rates depreciated. By these depreciations, the exports increased, and then, GDP growth rates were accelerated.

Table1 Demand factors analysis of Growth for Poland, Source IFS

	GDP Growth Rate	Consumption	Government Consumption	Gross Investment	Inventory	Export	Imports
1990	-11.07	-8.12	33.89	3.56	-3.7	1.98	-0.3
1991	-7.05	4.21	0.39	-4.06	-0.3	0.07	3.09
1992	1.81	6.11	-0.35	-1.69	7.96	1.79	1.43
1993	4.2	4	0.22	-0.25	0.25	0.66	1.65
1994	-1.45	0.38	-1.62	0.08	0	1.69	1.86
1995	7	1.22	3.57	1.01	-4.4	4.01	3.95
1996	6.16	5.28	0.55	3.51	0.13	2.33	6.12
1997	7.19	4.72	0.67	4.64	0.02	2.98	5.95
1998	4.93	3.61	0.6	3.42	0.02	5.16	8.39
1999	4.58	6.18	1.73	2.43	-0.1	-0.94	4.58
2000	4.15	0.86	0.01	-0.64	0.33	6.3	1.65
2001	1.11	2.16	0.85	-2.31	-0.1	2.54	0.54
2002	1.42	3.75	0.46	-1.36	0.26	1.7	2.74
2003	3.85	0.39	0.72	-0.04	-2.9	5.04	2.49
2004	5.24	3.06	0.91	0.99	6.54	4.15	5.75
2005	3.29	1.01	1.35	0.75	-0.5	3.39	1.9

	Growth Rate of M2	Growth Rate of Exchange Rate	Growth Rate of GDP Deflator
1990	160.12	-16.17	434.8
1991	36.95	53.8	55.27
1992	57.49	-0.85	38.49
1993	36.04	7.67	30.56
1994	38.23	0.55	37.35
1995	34.99	8.08	40
1996	30.96	8.49	18
1997	29.07	3.27	13.81
1998	25.17	5.66	11.13
1999	19.35	-2.46	6.03
2000	11.76	9.77	7.3
2001	15.04	12.7	3.5
2002	-2.77	-4.08	2.22
2003	5.7	-10.92	0.38
2004	6.91	-0.11	4.05
2005	12.21	11.64	2.81

Table 2 Demand factors analysis of Growth for Hungary, Source IFS

	GDP Growth Rate	Consumption	Gov. Consumption	Gross Investment	Inventory	Export	Imports
1990	-3.5	-4.46	-0.75	-3.72	0.67	-1.11	-5.2
1991	-11.9	2.88	-0.68	-0.48	1.21	-0.98	7.94
1992	-3.03	0.72	0.77	-1.55	-15	0.96	0.35
1993	-0.83	-0.19	1.8	-1.12	-1.3	-2.38	4.64
1994	3.16	0.4	-1.17	2.11	2.06	3.9	2.58
1995	1.36	-3.8	-0.73	0.44	0.7	19.49	9.85
1996	1.32	-2.24	-0.7	1.57	2.53	5.9	4.24
1997	4.6	1.41	0.97	2.17	0.52	11.95	12.4
1998	4.88	4.37	0.2	3.04	1.46	10.39	15.3
1999	4.13	3.63	0.33	1.08	-0.2	8.4	9.07
2000	5.21	1.56	-0.15	0.4	4.32	16.35	15.5
2001	3.81	3.63	0.99	0.86	-1.8	6.82	4.14
2002	3.58	4.76	1.25	0.91	-0.8	3.61	5.46
2003	2.91	4.7	0.56	-0.15	1.05	6.83	10
2004	6.84	3.67	0.18	1.45	-0.5	13.44	10.6

2005	4.56	1.61	-0.1	1.12	-0.3	9.51	6.13

	Growth Rate of M2	Growth Rate of Exchange Rate	Growth Rate of GDP Deflator
1990	29.19	10.89	25.67
1991	29.38	34.08	35.37
1992	27.3	14.17	21.48
1993	16.79	28.74	21.9
1994	13.44	13.46	19.24
1995	18	14.37	26.89
1996	21.18	25.34	21.19
1997	23.6	27.11	18.44
1998	30.33	15	12.62
1999	15.66	12.77	8.46
2000	12.61	20.07	9.89
2001	16.14	9.04	8.6
2002	14.1	-0.35	8.84
2003	12.45	-11.05	6.85
2004	8.89	-3.37	3.4
2005	13.31	0.41	2.53

Especially, in Hungary this trend was strong.

It is assumed that exports from these countries are competing in EU market and export goods are perfect substitutes. One central bank of these countries determines the optimal money supply, M2, given the money supply, M2 of another central bank. However, we have 1 problem which is how to make a relationship between GDP growth rate and the growth rate of price which is shown by GDP deflator. One way is to obtain the preference between GDP growth rate and the growth rate of GDP deflator from the regression, using data, with assuming these economies have been in Nash equilibrium. Another way is as follows. The indicator which shows utility is explained by GDP growth rate and the growth rate of GDP deflator by regression, and then the preference of these 2 variables are gained. In this paper, data of insurance premium has been used to express the utility. The data is from the Statistical Yearbook in these countries. It is assumed that confusions of these countries after reforms have been calmed down and risks have become constant. It is possible to use the insurance premium as the indicator of utility by this assumption. As described above, using the regression, the preference between GDP growth rate and the grow rate of GDP deflator has been obtained. At the same time, the relationship between GDP growth rate and the growth rate of

GDP deflator in the past for each country has been checked to keep the reality. Each central bank conducts optimization with satisfying the preference. In this way, Nash equilibrium has been introduced into the macro econometric model.

Under premises mentioned above, macro econometric models of Poland and Hungary, and the export market model have been built. Then, reaction functions have been estimated. After that, the simulation has been conducted.

Section 3 Equations of Estimation and Definition

Equations of estimation and definition of the macro econometric model are shown below. The figure in parentheses under the estimated value shows t value without plus or minus sign. DW shows Durbin-Watson value. R2 shows the coefficient of determination.

Table 3 Variables in Equations of Estimations and Definitions

1P1E	Real Export of Poland	1P1EDFLTR	Export Price of Poland
1P1EN	Nominal Export of Poland	1P1EXR	Exchange Rate of Poland
1P1FDI	FDI of Poland	1P1FDISTCK	FDI Stock of Poland
1P1GC	Real Gov. Consumption of Poland	1P1GDP	GDP of Poland
1P1GFCF	Gross Fixed Capital Formation of Poland	1P1HC	Real Household Consumption of Poland
1P1J	Real Inventory of Poland	1P1K	Capital Stock of Poland
1P1M	Real Imports of Poland	1P1M2	Money Supply, M2 of Poland
1P1MDFLTR	Imports Price of Poland	1P1MN	Nominal Imports of Poland
1P1PGDP	GDP Deflator of Poland	1P1POTGDP	Potential GDP of Poland
1P1R	The Interest of Poland	1P1EDOLN	Nominal Export of Poland in US Dollars
1P1EDOLR	Real Export of Poland in US Dollars		

D00	Dummy for 2000	D01	Dummy for 2001
D02	Dummy for 2002	D03	Dummy for 2003
D04	Dummy for 2004	D05	Dummy for 2005
D89	Dummy for 1989	D90	Dummy for 1990
D91	Dummy for 1991	D92	Dummy for 1992
D93	Dummy for 1993	D94	Dummy for 1994
D95	Dummy for 1995	D96	Dummy for 1996

D97 Dummy for 1997 D98 Dummy for 1998
D99 Dummy for 1999

2H2E Real Export of Hungary 2H2EDFLTR Export Price of Hungary
2H2EXR Exchange Rate of Hungary 2H2FDIFRT FDI of Hungary
2H2FDISTCK FDI Stock of Hungary 2H2GC Real Gov. Consumption of Hungary
2H2GDP Real GDP of Hungary GDP 2H2GFCF Gross Fixed Capital Formation of Hungary
2H2J Real Inventory of Hungary 2H2K Capital Stock of Hungary
2H2M Real Imports of Hungary 2H2M2 Money Supply, M2 of Hungary
2H2MDFLTR Imports Price of Hungary 2H2MN Nominal Imports of Hungary
2H2PC Real Private Consumption of Hungary 2H2PGDP GDP Deflator of Hungary
2H2POTGDP Potential GDP of Hungary 2H2R The interest Rate of Hungary
2H2EDOLN Nominal Exports of Hungary in US Dollars
2H2EDOLR Real Exports of Hungary in US Dollars

EDFLTRDOLPH Common Exports Price in US Dollars fro Poland and Hungary
EDOLPHR Total Real Exports in US Dollars for Poland and Hungary
GDPUSR Real GDP of US in US Dollars
PGDPUS GDP Deflator of US

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3.1 Polish Block

3.1.1 Household Consumption Function

（1）Sample period from 1989 to 2005

（2）Estimated equation

1P1HC = 251600.9 + 0.1102*1P1GDP + 0.7272*1P1M2 – 1P1PGDP – 49023.4*D90
（6.36） （1.56） （6.49） （2.46） （6.50）
- 26136.48*D91 – 25086.1* D01 -25134.8*D05
（3.31） （3.22） （2.98）

DW: 2.92

R2: 0.995

3.1.2 Investment Function

（1）Sample period from 1989 to 2005

（2）Estimated equation

1P1GFCF= -49899.4 + 279808.8*(1P1GDP/1P1K) – 69.6629*(1P1R/1P1PGDP)

(0.8386) (1.2752) (1.155)

+ 0.739*1P1GFCF(-1) – 15173.4*D02 + 14185.7*D98 -18159.7*D01

(4.8) (1.55) (1.55) (1.67)

DW: 1.56

R2: 0.918

Real gross fixed capital formation is explained by capital utilization ratio(1P1GDP/1P1K), capital cost(1P1R/1P1PGDP), and inertia.

3.1.3 Potential production function

(1) Sample period from 1989 to 2005

(2) Estimated equation

Log(1P1POTGDP) = -1.00065 + 0.04113*log(1P1FDISTCK) + 0.9682*log(1P1K)

(1.244) (14.428) (17.025)

+ 0.1699*D96 - 0.0282*D00 – 0.0235*D01

(1.324) (2.321) (1.911)

DW: 1.601

R2: 0.997

Potential production is explained by FDI stock and capital stock. In this model, technology choice is assumed to be conducted by the historical background. Capital-labor ratio is constant country to country (1).

3.1.4 Statistical equation for export deflator

(1) Sample period from 1989 to 2005

(2) Estimated equation

1P1EDFLTR = -0.66424・+ 0.374469*EDFLTRDOLPH*1P1EXR

(5.33065) (12.01607)

-0.44507*D89 + 0.155417*D90

(4.88598) (1.46423)

DW: 1.537211

R2: 0.952451

Export deflator of Poland is explained by the variable which is made by the exchange rate times the unique dollar price(2) determined in the common export market of Poland and Hungary.

3.1.5 Determination of imports deflator

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(1P1MDFLTR) = -3.36845 + 2.302949* LOG(1P1EXR)

(10.2877) (9.383628)

-1.89745*D89 + 0.462119*D90 -0.34822*D01

(9.92429) (2.088514) (2.16114)

DW: 1.7107

R2: 0.97205

3.1.6 Determination of GDP deflator

(1)・Sample period from 1989 to 2005

(2)・Estimated equation

1P1PGDP = -0.52371 + 0.706993*(1P1GDP/1P1POTGDP) + 1.03552* (1P1M2/1P1GDP)

(3.04224) (3.529356) (7.841412)

+ 0.324865* (1P1MDFLTR) + 0.102745* (1P1MDFLTR(-1))

(5.849354) (1.40977)

+ 0.047684*D02 + 0.011434*D96

(4.450842) (1.08349)

DW: 1.891

R2: 0.998

GDP deflator is explained by the ratio of GDP and potential production, the ratio of M2 and GDP, imports deflator, and imports deflator of 1 period before.

3.1.7 Determination of exchange rate

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(1P1EXR) = 1.304098 -0.47823*LOG(1P1EN/1P1MN) - 0.08141*LOG(1P1R/1P1PGDP)

(3.558205) (2.80566) (2.12381)

+ 0.218283* LOG(1P1EXR(-1))

(1.117945)

DW: 1.776

R2: 0.85001

The exchange rate is explained by the nominal ratio of export and imports, real interest

rate, and inertia.

3.1.8 Determination of the interest rate

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(1P1R) = -18.3232 - 3.02758* LOG(_1P1M2) + 2.527829* LOG(_1P1PGDP)
(0.87284) (2.4285) (2.133763)
+ 4.371208* LOG(_1P1GDP) - 0.81407*D03 - 0.90168*D04
(1.7199) (3.39332) (3.24861)
- 0.88816*D05 + 0.422358*D01
(3.10094) (1.702074)

DW: 2.0729

R2: 0.91326

The interest rate is determined by M2, GDP deflator, and GDP.

3.1.9 Definition of capital stock

1P1K'= 0.95'* 1P1K(-1)'+ 1P1GFCF

3.1.10 Definition of nominal imports

1P1MN'= 1P1M'* 1P1MDFLTR

3.1.11 Definition of the foreign direct investment

1P1FDISTCK'= 0.95'* 1P1FDISTCK (-1)'+ 1P1FDI

3.1.12 Definition of GDP

1P1GDP'= 1P1HC'+ 1P1GFCF'+ 1P1J'+ 1P1GC'+ 1P1E'- 1P1M

3.1.13 Imports function

(1)・Sample period from 1989 to 2005

(2) Estimated equation

LOG(1P1M) = -8.69911 + 1.562723*LOG(1P1GDP) -0.32394*LOG(1P1MDFLTR)
(1.78147) (4.3372) (1.5094)
+ 1.109623*LOG(_1P1PGDP) + 0.058329*D98 - 0.06004*D01
(5.250957) (1.91894) (1.9225)

DW: 2.22807

R2: 0.995138

3.2 Hungarian Block

3.2.1 Private consumption function

(1) Sample period from 1989 to 2005

(2) Estimated equation

2H2PC = 1900.987 + 0.1021*2H2GDP + 0.9143*(2H2M2/2H2GDP)

(4.52) (1.10) (5.70)

- 684.68*D90 -432.18*D98 – 384.42*D99 – 383.03*D00

(2.88) (1.85) (1.65) (1.63)

DW: 1.62

R2: 0.965

3.2.2 Investment function

(1) Sample period from 1989 to 2005

(2) Estimated equation

2H2GFCF = - 248.90 + 8914.03*(2H2GDP/2H2K) -2.93*(2H2R/2H2PGDP) + 0.39*GFCF(-1)

(0.437) (1.86) (3.46) (1.605)

DW: 2.147

R2: 0.964

Real gross capital formation is explained by capital utilization ratio (2H2GDP/2H2K), capital cost(2H2R/2H2PGDP), and inertia.

3.2.3 Imports function

(1) Sample period from 1989 to 2005

(2) Estimated equation

2H2M = -2403.99 + 1.547*2H2GDP - 9274.95*(2H2MDFLTR/2H2PGDP)

(1.15) (14.26) (9.84)

-1963.49*D89 + 1635.118*D00 – 925.0289*D94 + 693.286*D99 -700.795*D05

(3.30) (3.1) (1.69) (1.33) (1.13)

DW: 1.803

R2: 0.987

3.2.4 Potential production function

(1) Sample period from 1989 to 2005

(2) Estimated equation

2H2POTGDP = -1916.35 + 0.2391*2H2K + 0.6197*2H2FDISTCK

(0.4373) (2.7647) (11.5729)

DW: 1.803

R2: 0.987

Real potential production is determined by capital stock and FDI stock. It is assumed that the technology choice is conducted by the historical background and the capital labor ratio is constant, country to country(3).

3.2.5 Determination of imports deflator

(1) Sample period from 1989 to 2005

(2) Estimated equation

2H2MDFLTR = 0.1044 + 0.00324*2H2EXR + 0.0976*D96 – 0.1290*D02

(4.503) (27.041) (2.136) (2.660)

DW 値: 1.418

R2: 0.9798

3.2.6 Determination of GDP deflator

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(2H2PGDP) = 0.3249 + 0.5097*LOG(2H2GDP/2H2POTGDP) +
0.3437*LOG(2H2M2/2H2GDP)

(3.265) (1.482) (2.456)

+ 0.0986*LOG(2H2MDFLTR) + 0.5361*LOG(2H2PGDP(-1)) + 0.0764*D96

(1.918) (3.569) (4.610)

+ 0.0625*D97 – 0.0389*D05 + 0.0858*D95 + 0.0763*D91

(4.317) (2.343) (6.405) (3.518)

DW: 2.492

R2: 0.999

GDP deflator is explained by ratio of GDP and potential production, ratio of M2 and GDP, imports deflator, and imports deflator 1 period before.

3.2.7 Determination of exchange rate

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(2H2EXR) = 7.209 – 0.608*LOG((2H2E*2H2EDFLTR)/(2H2M*2H2MDFLTR))

(53.31) (1.52)

- 0.650*LOG(2H2R/2H2PGDP) – 0.4486*D05 - 0.326*D03 + 0.2161*D95
(18.84) (2.91) (2.135) (1.514)
+ 0.208*D96 + 0.1972*D97
(1.460) (1.372)

DW: 1.486

R2: 0.963

Exchange rate is explained by nominal ratio of export and imports and real interest rate.

3.2.8 Determination of interest rate

```
LOG(2H2R)・= 1.277559・- 11.65039495・* LOG (2H2M2 /2H2PGDP)・
           + 10.86791947・* LOG (2H2GDP)・- 1.241221428・* D89・
           + 1.68612671・* D92・- 1.189761633・* D97
```

Interest rate is determined by real M2 and GDP(4).

3.2.9 Definition of capital stock

2H2K・= 0.95・* 2h2K(-1)・+ 2H2GFCF

3.2.10 Definition of nominal imports

2H2MN = 2H2M・* 2H2MDFLTR

3.2.11 Definition of FDI stock

2H2FDISTCK = 0.95・* 2H2FDISTCK(-1)・+ 2H2FDIFRT

3.2.12 Definition of GDP

2H2GDP = 2H2PC + 2H2GC・+ 2H2GFCF・+ 2H2J・+ 2H2E・- 2H2M

3.3 Export block

3.3.1 Polish real export supply function in US dollars

(1) Sample period from 1989 to 2005

(2) Estimated equation

1P1EDOLR = -89752.7 + 30925.76*EDFLTRDOLPH + 24240.87*1P1EXR + 22716.7*D90
(2.498) (1.205) (5.481) (1.648)
19284.95*D05 + 18564.8*D03
(1.591) (1.598)

DW: 1.778

R2: 0.762

Polish real export in US dollars is explained by the common export price of Poland and Hungary, and Polish exchange rate(5).

3.3.2 Hungarian real export supply function in US dollars

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(2H2EDOLR) = 6.928 + 0.4038*LOG(EDFLTRDOLPH) + 0.6278*LOG(2H2EXR) – 0.2789*D94

(25.435) (1.159) (11.432) (1.947)

- 0.1225*D99 + 0.4411*D05 + 0.2111*D04

(0.844) (3.065) (1.387)

Hungarian real export in US dollars is explained by the common export price of Poland and Hungary, and Hungarian exchange rate.

3.3.3 Determination of common export price of Poland and Hungary

(1) Sample period from 1989 to 2005

(2) Estimated equation

LOG(EDFLTRDOLPH/PGDPUS) = -7.0363 – 0.511*LOG(EDOLPHR) +

1.397*LOG(GDPUSR)

(1.977) (4.065) (2.606)

-0.2034*D93 + 0.133*D95 – 0.1582*D01

(2.452) (1.60) (1.95)

DW: 1.787

R2: 0.778

The ratio of common export price of Poland and Hungary, and GDP deflator of US is explained by the sum of real export in US dollars in Poland and Hungary, and real GDP of US.

3.3.4 Definition of total and real export in US dollars of Poland and Hungary

EDOLPHR = 1P1EDOLR・+ 2H2EDOLR

3.3.5 Definition of Polish nominal export in US dollars

1P1EDOLN・= 1P1EDOLR・* EDFLTRDOLPH

3.3.6 Definition of Hungarian Nominal export in US dollars

2H2EDOLN = 2H2EDOLR・* EDFLTRDOLPH

3.3.7 Definition of Polish nominal export

1P1EN = 1P1EDOLN・* 1P1EXR

3.3.8 Definition of Hungarian nominal export

2H2EN = (2H2EDOLN・* 2H2EXR)・/ 1000

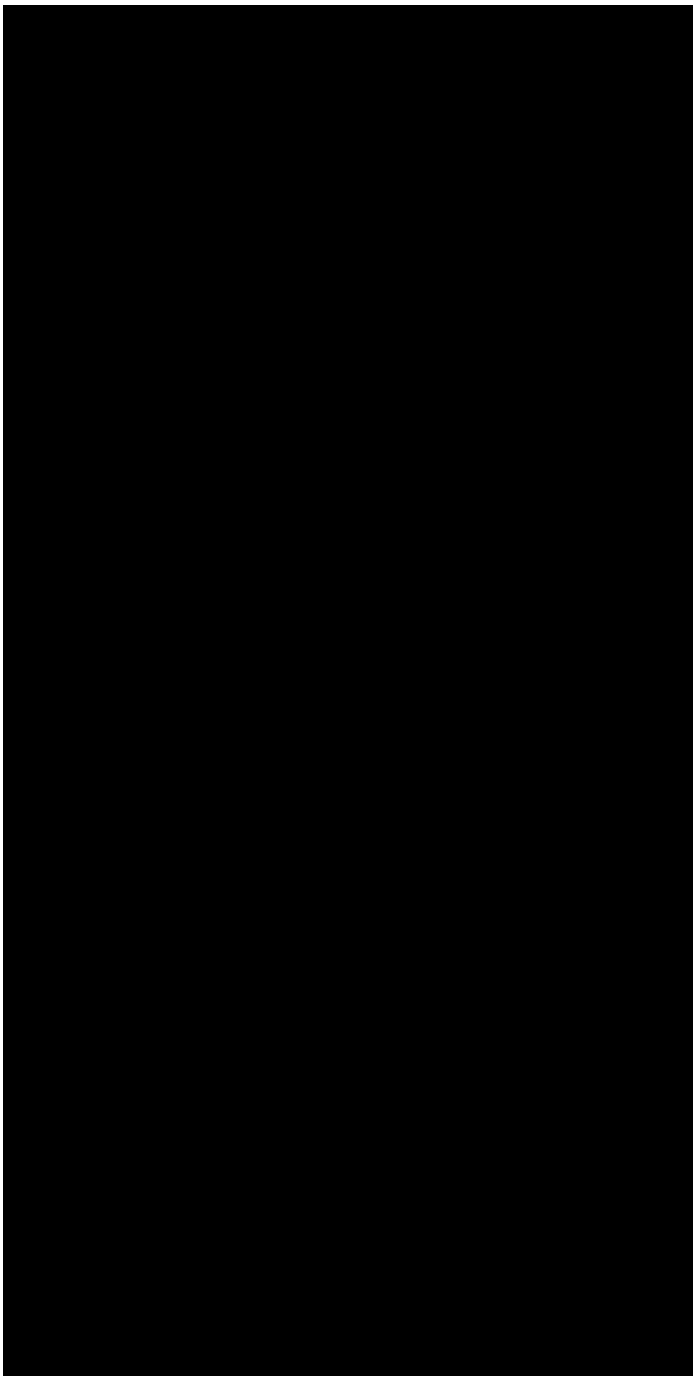
3.3.9 Definition of Polish real export

1P1E = 1P1EN・/ 1P1EDFLTR

3.3.10 Definition of Hungarian real export

2H2E = 2H2EN・/ 2H2EDFLTR

Table4 Result of Final test of Poland and Hungary model for main variables



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3.4 Final test

From 1992 to 2005, this model has been calculated. The maximum number of iterations is 5. It has been converged smoothly. In table 4, the results of calculation are shown for main variables.

3.5 Simulation

It is assumed that Polish and Hungarian export goods are competing in one export market. If the one country has an expansionary fiscal policy, the export increases through the depreciation of exchange rate, and GDP increases. It affects the export and GDP of another country. The one central bank of these countries determines the optimal money supply, M2, given the money supply, M2 of another central bank. The criterion of optimality is from GDP growth rate and the inflation rate. We have 2 ways to get the criterion, in other words, the preference, between GDP growth rate and the inflation rate shown in the growth rate of GDP deflator. One way is to obtain the preference between GDP growth rate and the growth rate of GDP deflator from the regression, using data, with assuming these economies have been in Nash equilibrium. Another way is as follows. The indicator which shows utility is explained by GDP growth rate and the growth rate of GDP deflator by regression, and then the preference of these 2 variables are gained. In this paper, data of insurance premium has been used to express the utility (6). The data is from the Statistical Yearbook in these countries. It is assumed that confusions of these countries after reforms have been calmed down and risks have become constant. It is possible to use the insurance premium as the indicator of utility by this assumption.

In the case of 2nd way, it has been possible to get a satisfied result for Poland, but has been impossible for Hungary. For Hungary, the 1st way has been adopted. The preference between GDP growth rate and GDP deflator in Hungary has been determined, from the regression, using data, with assuming these economies have been in Nash equilibrium.

It is assumed that the utility of the central bank corresponds to the utility of people (7). Also, it is assumed that confusions of these countries after reforms have been calmed down and risks have become constant. It is possible to use the insurance premium as the indicator of utility by this assumption (8). Because there are no insurance for inflation, GDP deflator is the variable which shows risk, with assuming that other risks for which insurances exist are constant.

$$\text{Log } u = \alpha * \log \text{GDP} + \beta * \log \text{PGDP} + \gamma$$

$$(du/dt)/u = \alpha * (dGDP/dt)/GDP + \beta * (dPGDP/dt)$$

If we assume as follows,

$$\log u = \alpha * \log \{(GDP^{\wedge}\gamma)/PGDP\} + C$$

Then, we have

$$(du/dt)/u = \alpha * \{ \cdot \gamma * \{ (dGDP/dt)/GDP \} - \{ (dPGDP/dt)/PGDP \} \cdot \}$$

We have the preference of GDP growth rate and the growth rate of GDP deflator, as follows.

(dPGDP/dt)/PGDP =γ(dGDP/dt)/GDP

Assumed γ = 6.22,

(1)・Sample period from 1989 to 2005

(2)・Estimated equation

log (1P1INSPVC) = -32.28 + 0.50124*log(1P1GDP^6.22/1P1PGDP) – 0.2598*D93

(10.247) (13.36) (3.288)

-0.1620*D95 – 0.1025*D98 + 0.08153*D01

(1.937) (1.353) (1.085)

DW: 1.551

R2: 0.963

Above equation has been gained.

Because γ=6.22 has been supported statistically, the preference between GDP growth rate and the growth rate of GDP deflator is 6.22. For Hungary, the preference between GDP growth rate and the growth rate of GDP deflator has been calculated as 1.22, as the result of regression, assuming this economy has been in the Nash equilibrium.

At first, the growth rate of M2 in Hungary has been assumed to be 13%. Then, the growth rate of M2 in Poland has been assumed to be 5%, 8%, 10%, 12%, and 15%. In each case, the model has been solved from 2006 to 2010. As the result, when the growth rate of M2 in Poland is 5%, GDP growth rate becomes 1.02% on average from 2006 to 2010. Then, the growth rate of GDP deflator becomes 6.34% on average. The ratio of growth rate of GDP deflator and the GDP growth rate is 6.22. For Poland, if the growth rate of M2 in Hungary is 13%, it is the optimum policy to make the growth rate of M2 5%. In similar manner, when the growth rate of M2 in Hungary is assumed to be 20%, it is the optimum policy for Poland to make the growth rate of M2 3.15%. From this way, **the reaction function of Poland** is estimated as follows.

(1p1m2-(1p1m2(-1)))/(1p1m2(-1))

= (-0.261)*(2h2m2-(2h2m2(-1)))/(2h2m2(-1)) + 8.36

In the next, **the reaction function of Hungary** has been gained as follows.

At first, the growth rate of M2 in Poland has been assumed to be 8.14%. Then, the growth rate of M2 has been assume to be 5%, 8.1%, 10%, 13%, 15%, 20%, 25%, and 30%. In each case, this model has been solved from 2006 to2010. As the result, when the growth rate of M2 in Hungary is 20%, GDP growth rate becomes 8.62% on average and the growth rate of GDP deflator becomes 10.52% on average. Then the ratio of the growth rate of GDP deflator and GDP growth rate is 1.22. This is the optimal monetary policy for Hungary. Then, the growth rate of M2 in Poland has been

assumed to be 15%. Then, the growth rate of M2 in Hungary has been assume to be 5%, 8.1%, 10%, 13%, 15%, 19.5%, 20%, 30%. In each case, this model has been solved from 2006 to2010. As the result, when the growth rate of M2 in Poland is 15%, the optimal growth rate of M2 in Hungary becomes 19.5%. By this way, the reaction function of Hungary is estimated as follows.

$$(2h2m2-(2h2m2(-1)))/(2h2m2(-1))$$
$$= (-0.073)*(1p1m2-(1p1m2(-1)))/(1p1m2(-1)) + 20.59$$

If we solve these 2 equations (reaction functions) mentioned above simultaneously, we have a solution as follows.

$$(1p1m2-(1p1m2(-1)))/(1p1m2(-1)) = 3\%$$
$$(2h2m2-(2h2m2(-1)))/(2h2m2(-1)) = 20\%$$

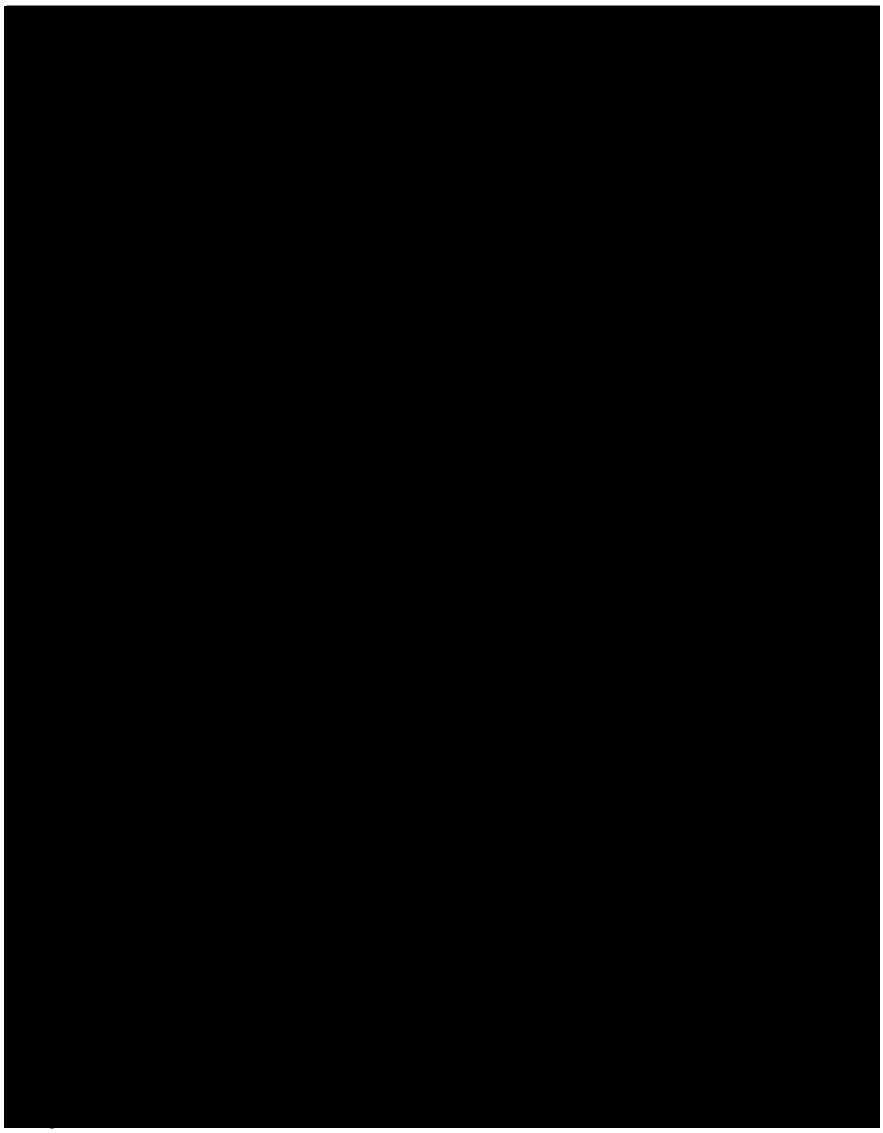
Therefore, we have the Nash equilibrium when we assume the growth rate of M2 in Poland, 3% and in Hungary 20%. Under this premise the simulation has been conducted. The result is in the table 5.

When the money supply M2 in Hungary increases, GDP deflator increases through the equation of determination of GDP deflator. The interest rate decreases by the equation of determination of interest rate (Money demand function). According to this movement, the exchange rate decreases and the Hungarian real export in US dollars increases. By the decrease of exchange rate, the common export price of Poland and Hungary has a pressure to decrease. But the effect to this equation from the real GDP of US is large. Therefore the common export price has shown the large negative growth minus 16% in 2006, and then, shown around 5% continuously. The real export of Hungary in US dollars has decreased in 2006, but after that, has increased more than 10% continuously. The real export of Hungary in national currency has decreased 6% in 2006, but after that has increased more than 10% continuously. GDP deflator of Hungary has increased always around 10%. The exchange rate of Hungary has always depreciated more than 10%. GDP of Hungary has shown large growth driven by the export. It has recorded large growth rate, always around 10%, from 9.1% in 2006 to 10.5% in 2010.

On the other hand, the growth rate of M2 in Poland is 5% in every year. This is smaller than 20% in Hungary. Therefore, the result is much different compared with Hungary. According to the increase of M2, GDP deflator increases. The interest rate increases in 2006 and 2007. This is because the effect of GDP deflator to the interest rate is large. The exchange rate decreases in 2006 and 2007. But, this decrease is smaller than the case in Hungary. The growth rate of real export of Poland in US dollars has a similarity. It is 0.04% in 2006 and 7.2% in 2007. It starts to decrease in 2008. It is because the growths of Hungarian export in US dollars very large in the same export market. The real export of Poland in national currency decreases by 4% in 2006. Then, it increases

by 2.2% in 2007. But, from 2008 it decreases continuously. GDP deflator shows large increases in 2006 and 2007. But, from 2008, it decreases by around 2% in every year. The exchange rate of Poland appreciates by around 2% every year from 2008. According to the sluggish export, GDP growth rate shows .small figures, minus 0.2% in 2006, minus 0.2% in 2007, and around 1% from 2008.

Table 5 Result of Dynamic Game Simulation of Poland and Hungary Model



by author

Conclusion

It is possible to find trends recently in Poland and Hungary, as follows. At first, central banks increase the money supply, M2, and exchange rates depreciate. According to depreciations, exports increase and GDP growth rates are accelerated. Especially, in Hungary this trend is strong. It is assumed that exports from these countries are competing in EU market and export goods are perfect substitutes. One central bank of these countries determines the optimal money supply, M2, given the money supply, M2 of another central bank. However, we have 1 problem which is how to make a relationship between GDP growth rate and the growth rate of price which is shown by GDP deflator. One way is to obtain the preference between GDP growth rate and the growth rate of GDP deflator from the regression, using data, with assuming these economies have been in Nash equilibrium. Another way is as follows. The indicator which shows utility is explained by GDP growth rate and the growth rate of GDP deflator by regression, and then the preference of these 2 variables are gained.

Under this premise, macro econometric models for Poland and Hungary have been built. Then, the optimal money supply, M2 of one country, when another country increases the money supply, M2 has been gained, with solving models. Reaction functions for these countries have been obtained, repeating this process. By solving 2 reaction functions, growth rates of M2 under the Nash equilibrium have been acquired.

Simulation has been conducted from 2006 to 2010. In the case of Hungary, the increase of GDP deflator, the decrease of interest rate, and the depreciation of exchange rate have been observed clearly. As the result, the export in US dollars and in national currency has increased largely. Then, GDP has increased by around 10% continuously. In the case of Poland, because the growth rate of M2 has been rather small, the interest rate has not decreased so much. Then, the response of exchange has been small, also. The increase of Polish export in US dollars and in national currency has become small. GDP growth rate shows figures of around 1% after small negative values.

(1) Trefler, Daniel (1993), Trefler, Daniel(1995)

(2) Export prices in US Dollars for Poland and Hungary were calculated, then the integrated export price was obtained, using weighted averages by export shares.

(3) Trefler, Daniel (1993), Trefler, Daniel(1995)

(4) Money Demand Function

LOG(2H2M2/2H2PGDP) = 0.1097 – 0.0858*LOG(2H2R) + 0.9328*LOG(2H"GDP)
(0.0462) (1.224) (4.025)

- 0.1065*D89 + 0.1447*D92 – 0.1021*D97
(1.991) (2.612) (1.9132)

DW: 1.544

R2: 0.918

was estimated at first, then, was transformed to the definition of interest rate.

(5) If Zloty depreciate in Poland, the supply function shifts to right. Then, the common export price decreases and the equilibrium point moves.

(6) In the case of Poland, the insurance can be divided to the compulsory and the voluntary. In this paper, the insurance premium is the sum of them. In the case of Hungary can not be divided. In the case of Poland, the ratio of premium to GDP is higher compared with Hungary. I may be possible to say that Polish is more risk averter compared with Hungarian. This is accordance with the intuition.

(7) It is said that this depends on the taste of president of central bank.

(8) Poland Statistical Yearbook, Hungary Statistical Yearbook

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