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소규모 개방경제국가의 수익률곡선과 통화정책

The Yield Curve and Monetary Policy in a Small Open Economy

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논 문 초 록

1. 국문요약(국문초록)

본 논문은 소규모 개방경제국가들 간의 수익률 곡선이 어떠한 상관관계를 가지는지에 대해 분석하고, 각 국가들의 통화정책이 효율적인지 검토한다. 첫째로, dynamic factor model을 사용하여 호주, 캐나다, 덴마크, 노르웨이, 스위스, 그리고 영국의 여섯 개 국가 수익률곡선들의 공통적인 움직임을 찾아낸다. 이 실증적 분석은 각국의 명목 이자율이 미국의 대응되는 이자율과 밀접한 연관이 되는 한편 각국의 정책 이자율과는 장기적으로 다소 관련이 없다는 결과를 얻어낸다. 이와 같은 결과는 장기적으로 소규모 개방경제국가의 단기 이자율 정책이 효과를 얻지 못함을 의미할 수 있기 때문에, 캐나다와 노르웨이를 비교분석하여 확장적 통화정책의 효과도 함께 살펴보았다. VAR 모형을 사용하여 미국 이자율과 자국의 이자율이 높은 상관관계를 가지는 경우 해당하는 소규모 개방경제국가가 정책 효과를 크게 보지 못함을 밝혀낸다. 미국의 이자율과 비교적 가장 낮은 상관관계를 가지는 것으로 밝혀진 노르웨이의 경우, 자국의 정책이자율을 낮춤으로 인해 경기를 부흥시키는 데에 어느 정도 성공하였다. 반면에 조사 대상국들 중 미국과 가장 높은 이자율 상관관계를 가지는 것으로 보인 캐나다의 경우에는 확장적 통화정책의 결과 경기를 활성화시키는 데에 성공하지 못한 것을 확인할 수 있다.

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주요어 : 소규모 개방경제국가, 통화정책, 수익률 곡선

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2. 외국어초록(Abstract)

The Yield Curve and Monetary Policy in a Small Open Economy

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This paper analyzes co-movements among the yield curves of small open countries, and the efficiency of each country's monetary policy. First, I estimate a dynamic factor model to find common movements among the yield curves of six small open countries: Australia, Canada, Denmark, Norway, Switzerland, and the United Kingdom. The empirical results show that nominal interest rates of the countries are well-accounted for by their US counterpart, rather than the small open countries' policy rates at long maturities. This may imply that the long-term rates decouple from the short-term policy rates in the small open countries, resulting in limited effects of the countries' monetary policy. Thus, to examine the effectiveness of monetary policy, I analyze dynamic responses of macro variables to monetary expansions in Canada and Norway. Estimating a vector auto-regression (VAR) model, I conclude that the high yield curve correlations with the United States reduce the impacts of expansionary monetary policy in small open countries. Norway, whose interest rates are the least explained by the US rates, succeeds in boosting its economy by decreasing the policy rate. On the other hand, Canada, which has the highest yield curve correlations with its US counterpart, fails to

invigorate economic activities by monetary expansion.

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keywords : Small Open Economy, Monetary Policy, Yield Curve

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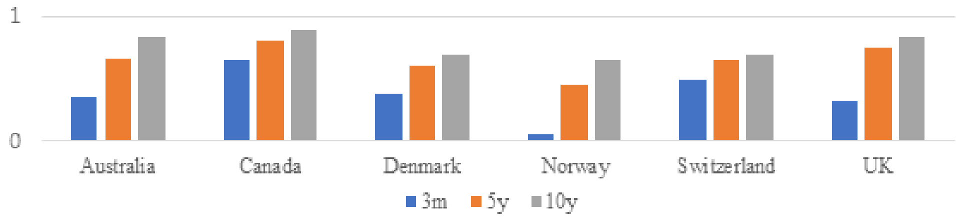
1. Introduction

Since interest rates are linked with various macro variables, it is important to understand a country's yield curve. A large amount of literature has suggested that the long-end of the yield curves of small open countries show a higher correlation to their US counterpart than the short-end (see Kulish and Rees (2011), Bernanke (2013), and Jotikasthira et al. (2015)). Figure 1[1] confirms the stylized fact for six small open countries: Australia, Canada, Denmark, Norway, Switzerland, and the United Kingdom. In this graph, it is clear for all the six countries that long-term yields are more correlated with the US interest rates rather than at shorter maturities.

Figure 1. Correlations of the yield curves with the US counterparts



Because the long-term nominal interest rates tend to co-move with their US counterparts, it is possible that the long-term rates have decoupled from the countries' policy rates. This implies that a small open country's monetary policy may have limited impacts on improving the economy. The United States may not be affected by these co-movements because it is regarded as a large open country. Bomfim (2003) confirms that monetary policy is the primary mover of the yield curve in the United States. However, it is worth scrutinizing the effects of monetary policy in small open countries listed above.

Previous studies have argued that this observation does not mean

1) "3m", "5y", "10y" each means 3-month, 5-year, 10-year government bond yield.

the separation of long-term interest rates from their policy rates. Rotemberg and Woodford (1997) provide a standard monetary model, suggesting that long-term nominal interest rates do not deviate from the expected path of the short-term policy rate. Kulish and Rees (2011) argue that the high correlations between the long-term rates can be explained by a model including expectations hypothesis and uncovered interest rate parity. Chin et al. (2005) also explain that the correlated policy expectation is the reason for the perceived co-movements, using a small open economy DSGE model. In this paper, I focus on empirical analysis rather than establishing a model to explain the phenomenon. I use a dynamic latent factor model to analyze the co-movements among small open countries' yield curves, and estimate a vector auto-regression model to examine the efficiency of the countries' monetary expansion.

My empirical work begins with finding common factors of six small open countries' nominal interest rates, estimating a dynamic factor model. The dynamic latent factor model has been used for the yield curve analysis by many researchers (see Diebold et al. (2006, 2007), Ang and Piazzesi (2001)). While these studies incorporate macro variables into multifactor yield curve models, I instead focused on finding common factors among the yield curves of different countries, and scrutinized their movements. I discovered that the small open countries' long-term nominal interest rates are well-explained by their US counterpart rather than their own policy rates. Although the short-term interest rates are considerably correlated with the policy rates, the correlation with the US counterpart is much greater at longer maturities. This finding is consistent with the observation in Figure 1, and leads me to cast doubts on the effectiveness of operating each country's policy rates.

The next part of this paper's analysis concentrates on the effects of monetary policy. I have chosen to examine Canada and Norway, because they demonstrate the highest and the lowest yield curve correlations with the United States, respectively. A large number of studies such as Kim (2001), Canova (2005), Mackowiak (2007) show that the US monetary policy has a significant impact on many countries. A country may experience limited consequences of its own monetary policy if the US policy has a great influence on the country. I assume that small open country may be more affected by the United States than others are if its interest rates are closely related with its US counterpart. This is because the small open country's economy will co-move with the US economy. Based on this hypothesis, I have estimated a vector auto-regression (VAR) model to obtain impulse responses of domestic macro variables to each country's monetary expansion. Many papers have used VAR models to analyze the impact of monetary policy (see Sims and Zha (1998), Kim (2001), and Chirstiano et al. (1998)). My methodology is closely related with Peersman and Smets (2001) in that I include exogenous variables to control for fluctuations in the world economy. With the dynamic responses of economic variables, I have found that close relationships with the United States imply the limited impacts of monetary expansion in a small open country. While Norway succeeds in invigorating its economy, Canada fails to increase real gross domestic product (GDP) and consumption significantly. Unlike Canada, Norwegian monetary policy is also effective in inducing positive responses of durable consumption and dwelling investment, which represent people's long-term decisions. These empirical observations indicate that the impact of a small open country's monetary policy is rather restricted when it is more closely related to the United States in terms of the yield curve. It may be required for the country to deliberate on its policy effects and the transmission channels of foreign shocks.

The rest of this paper proceeds as follows. The next section provides explanations for data. Section 3 describes empirical works for the yield curve co-movements. Section 4 analyzes the effectiveness of a small open country's monetary policy, and Section 5 concludes.

2. Data

In section 3, I analyze co-movements among the yield curves[2] of six small open economies: Australia, Canada, Denmark, Norway, Switzerland, and the United Kingdom. I use monthly HP-filtered data on the countries' 3-month, 5-year, and 10-year nominal interest rates for the period 1997.6 - 2017.6. To further describe these movements, I also utilize monthly HP-filtered data on the small open countries' policy rates, the US yield curves, and the Industrial Production (IP) Index of the United States for the same period.

In section 4, I compare the effects of expansionary monetary policy in Canada and Norway. I use quarterly data on the countries' real GDP per capita, CPI (Consumer Price Index), PPI (Producer Price Index) for manufacturing, M1 money supply, Exchange rates, Final Private Consumption, Gross Fixed Capital Formation, Consumption for durable goods, and Fixed Capital Formation for dwellings and buildings for the period 1997.Q3-2017.Q2. All the data are obtained from OECD statistics.

3. The Yield Curve Co-movements

In this section, I find two common factors for each bond yield (3-month, 5-year, and 10-year). of the six small open countries.

2) In this paper, nominal interest rates refer to government bonds yields.

Further, these factors are compared to the small open economies' policy rates and the US interest rates.

3.1. Dynamic Factor Model

The dynamic latent factor model was suggested and advanced by Stock and Watson (1998), and Forni et al. (2000). This approach has stemmed from the idea that some unobserved factors can identify common movements in macroeconomic variables across countries.

The general model specification assumes that Y_t can be separated as:

$$Y_t = AY_{t-1} + BZ_t + e_t$$

where $v(e_t)=\sigma_i^2$ for all i, and $E(e_ie_j) = 0$ for $i \neq j$. The B matrix, which is known as factor loadings, measures the instantaneous impact of common factors on each series Y_t. In most cases, A is assumed to be diagonal, so the dynamic factor model implies that the co-movements of the multiple time series arise from the single source Z_t.

The dynamic process of the state factor Z_t is assumed to follow:

$$Z_t = \lambda Z_{t-1} + \eta_t$$

where $v(\eta_t) = I$ for all t. We can also assume that λ is diagonal so that the dynamics of the unobservable factors is univariate. In this paper, I focus on two latent factors.

3.2. Estimation

The paper's empirical work begins with estimating two common factors of 3-month, 5-year, and 10-year nominal interest rates each for six small open countries. Each nominal rate represents the short-term, mid-term, and long-term interest rate.

Figure 2 presents the two estimated latent factors of nominal interest rates for the small open economies. Notably, the interest rates rapidly decrease in the period of 2008 financial crisis, which can be confirmed with the first common factors of the rates. Table 1 shows the results of cumulative variance decomposition in the context of the shares of variance associated with the latent factors. In this table, most nominal interest rates are well accounted for by the first common factor, which can also be verified in Table2's description of the marginal shares of variance. Exceptionally, the second factor's variance explains around 55 percent of Canadian short-term interest rate variance, which means it moves differently from the other countries. However, the table documents the large role played by the

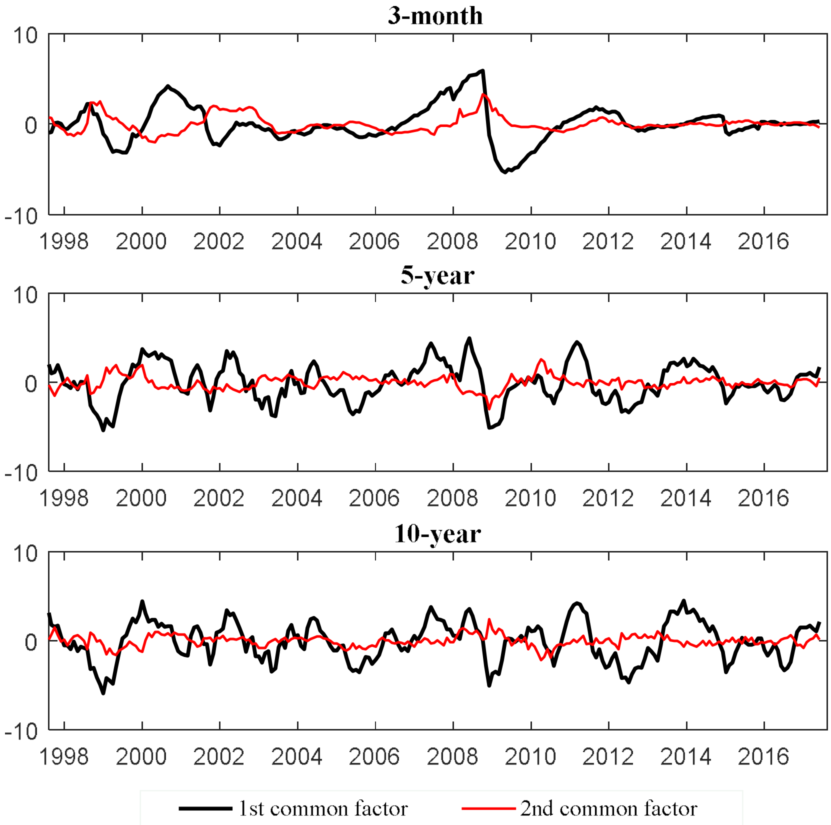


Figure 2. Two components of the yield curves

first common factor in most cases.

From 3-month to 10-year bond yields, cumulative shares of variance accounted for by common factors increased in all six countries. Most countries' long-term rate variances are explained approximately 10 percent point more than in the short run. Also, the presented numbers are the highest in Canada and the lowest in Norway. This interpretation is equally applicable to the first factor alone.

Table1. Shares of variance accounted for by the common factor (cumulative)

	Australia	Canada	Denmark	Norway	Switzerland	UK
3-month						
1st	0.559	0.242	0.731	0.604	0.570	0.758
2nd	0.615	0.795	0.743	0.647	0.606	0.774
5-year						
1st	0.846	0.836	0.762	0.577	0.733	0.789
2nd	0.854	0.845	0.830	0.650	0.798	0.796
10-year						
1st	0.870	0.906	0.803	0.676	0.794	0.850
2nd	0.875	**0.911**	0.876	**0.710**	0.874	0.860

Table2. Shares of variance accounted for by the common factor (marginal)

	Australia	Canada	Denmark	Norway	Switzerland	UK
3-month						
1st	0.559	0.242	0.731	0.604	0.570	0.758
2nd	0.057	0.553	0.012	0.043	0.037	0.016
5-year						
1st	0.846	0.836	0.762	0.577	0.733	0.789
2nd	0.008	0.009	0.068	0.073	0.065	0.007

10-year						
1st	0.870	**0.906**	0.803	**0.676**	0.794	0.850
2nd	0.005	0.004	0.073	0.034	0.080	0.009

Figures 3 and 4 plot the observed movements of the estimated latent factors, the US yield curves, policy rates, and the US Industrial Production (IP). To see the co-movements accurately, the plots are re-scaled with standard deviations. Since most countries' interest rate variances are well-accounted for by the first common factors, I have only investigated the first factor in analyzing the movements.

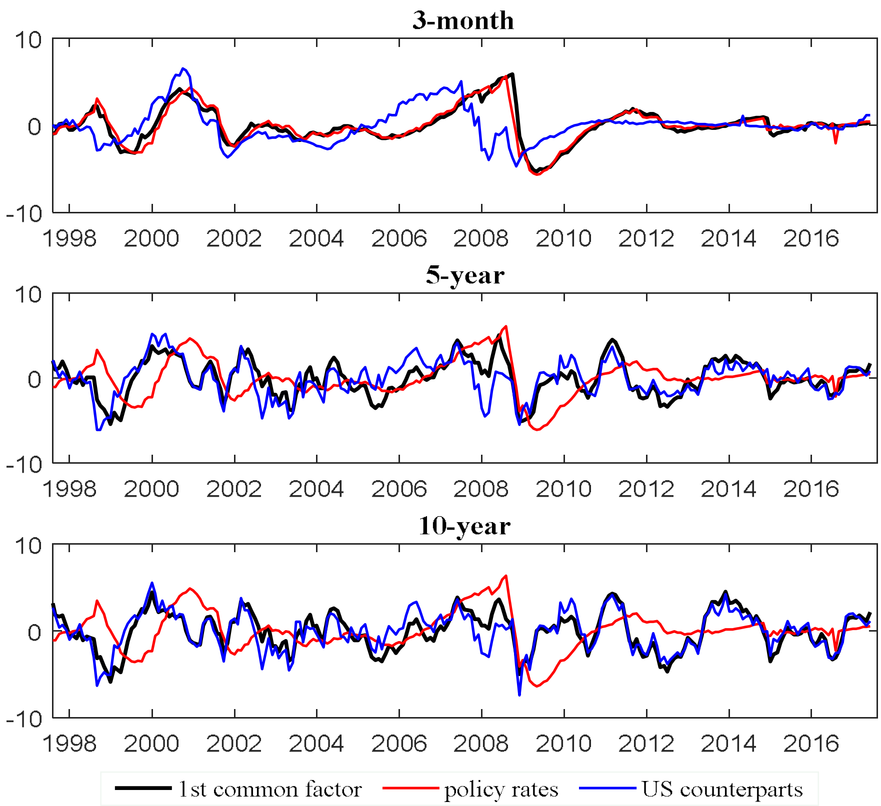


Figure 3. 1st common factors, policy rates, and the US counterparts

To further understand the movements of the yield curves, I have analyzed correlations between the latent factors and the other variables in Table 3. In the mid- and long-term, the first cofactors of the countries' nominal rates move closely with the US counterparts. The correlation between the mid-term first latent factor and the US counterpart is 75.5 percent, which increases to 85.1 percent in a 10-year bond yield. This outcome is consistent with the fact that small open countries' long-term nominal rates are highly correlated with their US counterpart more than rates at shorter maturities. Also, approximately 90 and 67 percent shares of variances respectively in Canadian and Norwegian long-term rates, reported in Table 2, is also explicable in this context. Referring to Figure 1, the empirical result is in line with the fact that Canadian rates have the highest correlations with their US counterpart while Norwegian rates are the least correlated ones.

Table 3. Correlations with the first common factors

	US Counterparts	Policy Rates	US IP	USSR
3-month	0.451	0.909	0.725	0.461
5-year	0.755	0.351	0.412	0.241
10-year	0.851	0.176	0.242	0.078

* "Policy Rates" refers to the one co-factor of the 6 countries' policy rates.
* "IP" refers to Industrial Production.
* "USSR" refers to the US shadow funds rate.

Therefore, it is possible to recall the doubts cast by several skeptics that short-term policy decisions may have limited consequences on long-term interest rates. In Table 3, policy rates appear to be highly correlated with the cofactor of short-term interest rates. However, the correlations in 5-year and 10-year yield are only 35.1 and 17.6 percent, which are even lower than the correlations between the cofactors and the US industrial production. Thus, it is reasonable to assume that the long-term interest rates of the small open countries deviate from the policy rates.

Table 4. Correlations with the first common factors

	US Counterparts	Policy Rates	US IP	USSR
3-month	0.779	0.976	0.878	0.311
5-year	0.876	0.328	0.322	-0.136
10-year	0.951	0.138	0.114	-0.227

* "Policy Rates" refers to the one co-factor of the 6 countries' policy rates.
* "IP" refers to Industrial Production.
* "USSR" refers to the US shadow funds rate.

In Table 4, I have analyzed correlations between the latent factors and the other variables after 2008 global crisis. The first cofactors have even higher correlations with the US counterparts. In the mid- and long-term, the first cofactors of the countries' nominal rates' movements are considerably close with the US counterparts, which increases from 87.6 percent to 95.1 percent in a 10-year bond yield. This outcome may imply that analyzing the interest rate co-movements is becoming more significant in recent days.

4. Efficiency of Monetary Policy

In section 3, the empirical work shows that long-term nominal interest rates are highly correlated with and well accounted for by the US counterpart much more than the policy rates. In this section, I examine the impacts of monetary expansion in Canada and Norway, which have the highest and lowest correlations with the United States in terms of interest rates, respectively. Each country also has the highest and the lowest shares of variances accounted for by the long-term interest rate's first latent factor obtained in section 3, which is considerably related to the US long-term nominal rate. With this study, I aim to examine whether the high correlations of the long-term nominal interest rates with the US interest rates contribute to the limited effects of each country's monetary policy.

4.1. The Benchmark Specification

To analyze a monetary policy shock in Canada and Norway, I have described a benchmark VAR model. The VARs have the following representation:

$$Y_t = A(L)Y_t + B(L)X_t + e_t$$

where X_t is a vector of exogenous foreign variables and Y_t is the vector of endogenous variables.

The vector of exogenous variables, X_t, contains a world price index (wp_t), US real GDP (y_t^{us}), and the US shadow funds rate (usr_t)[3]:

$$X_t' = [wp_t \quad y_t^{us} \quad usr_t]$$

These variables are included to control for changes in world demand and inflation. These exogenous variables are assumed to receive no feedback from Canadian and Norwegian variables. Meanwhile, the exogenous variables have a contemporaneous impact on the endogenous variables. This assumption is reasonable since Canada and Norway are well-known as small open countries.

The vector of endogenous variables, Y_t, consists of real GDP (y_t), inflation rate (p_t), producer prices for manufacturing (pc_t) policy rate (r_t), M1 money supply (m_t), and the exchange rate (x_t):

$$Y_t' = [y_t \ p_t \quad pc_t \quad r_t \ m_t \quad x_t]$$

Monetary policy shock is identified through a standard Cholesky decomposition with the variables ordered above. It is assumed that monetary shocks have no contemporaneous impact on output and

3) The VAR model also contains a constant and a linear trend.

prices, but may affect money and the exchange rate immediately.

By extending the basic system, I also examine the effects on various domestic macro variables. Measures of consumption (c_t), investment (i_t), durable consumption (d_t), and dwelling investment (dw_t) are additionally included one by one between y_t and p_t[4]. In the dynamic responses of the extended estimation, the responses of the basic variables in the extended identification are consistent with those in the basic system.

4.2. Estimation

With the above identification scheme, I have compared the effects of monetary expansion in Canada and Norway. Figure 4 depicts impulse responses of real GDP (y) and consumption (c) to expansionary policy in each country[5]. In this example, Norwegian variables' responses to a negative shock in the interest rate are generally larger than those of Canada. Especially in terms of consumption, Norway shows a significant and persistent rise in response to the monetary policy while Canadian consumption variable does not increase significantly.

To better illustrate the impacts of monetary policy, Table 4 demonstrates the peak and median responses in exact numbers. Interestingly, a drop in the Norwegian interest rate is more efficient in boosting its economy. While Norway's real GDP and consumption increase more than 20 percent with the fall in the interest rate, Canadian indicators increase less than 10 percent.

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4) Through the estimation, wp_t, y_t^{us}, y_t, m_t, x_t,pc_t are differenced to eliminate trends . All variables are logged except for the interest rates.

5) Each graph shows impulse responses over 16 quarters with 68% probability bands.

Table 4. Analysis of Impulse Responses (y and c)

	Canada			Norway		
	max	med		max	med	
real GDP (y)	0.0839	0.0462	(0.018)	0.3342	0.2147	(0.072)
consumption (c)	0.0428	-0.0032	(0.019)	0.3036	0.2648	(0.078)

* Standard deviations are in parenthesis.

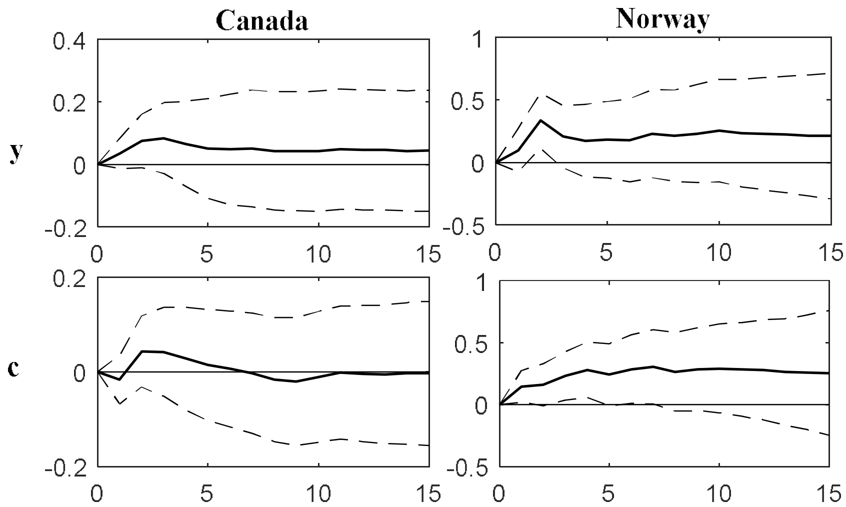

Figure 4. Impulse responses of y and c to monetary expansions

Further to this, I have estimated the efficiency of monetary expansions in the long run, comparing durable consumption (d_t) and dwelling investment (dw_t) in Canada and Norway. Since those activities are decisions to consider in the long run, this analysis would be effective in investigating the long-term impacts of monetary policy. Figure 5 plots the variables' dynamic responses to the fall in each country's interest rate. It is interesting that differences in the responses are even larger than those in Figure 4. Durable consumption and dwelling investment in Canada do not increase significantly in response to the decrease in its policy rate. However, the variables in Norway positively react to the country's expansionary monetary shock.

Table 5 documents the maximum and median of the impulse responses, demonstrated in Figure 5. While Norwegian variables show a considerable increase in response to its monetary expansion, a fall in the Canadian policy rate fails to raise durable consumption and dwelling investment. The monetary policy may not be sufficient enough in inducing long-term decisions because Canada's long-term interest rates tend to divorce from their policy rates.

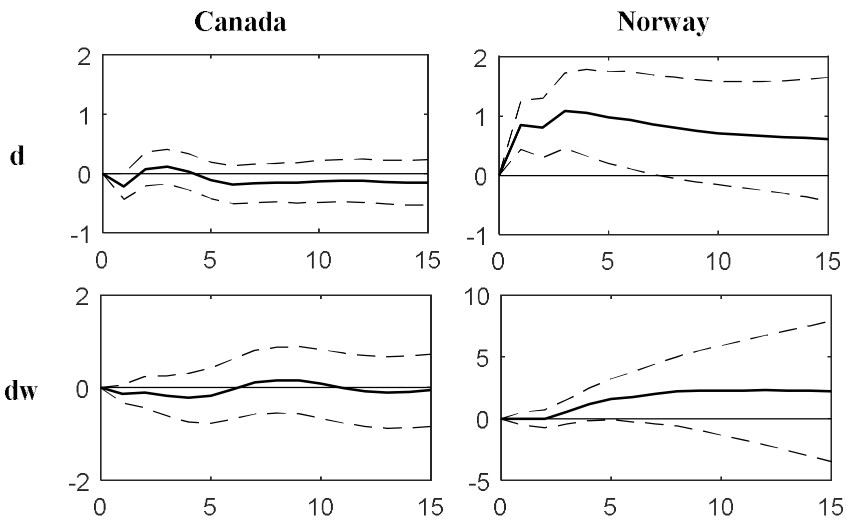

Figure 5. Impulse responses of durable consumption and dwelling investment

Table 5. Analysis of Impulse Responses (d and dw)

	Canada			Norway		
	max	med		max	med	
durable consumption (d)	0.1157	-0.1381	(0.099)	1.0862	0.7765	(0.250)
dwelling investment (dw)	0.1639	-0.0618	(0.119)	2.304	2.1076	(0.922)

* Standard deviations are in parenthesis.

Table 6 reports the average variance decomposition of domestic macro variables to each country's monetary shocks. Canada's monetary policy shocks explain 0.8-2.7 percent of the variables, while the expansionary shocks in Norway account for 9.6-20.7 percent of the economic activities, which is relatively large.

Table 6. Forecast error variance decomposition due to monetary shocks

	y	c	i	d	dw
Canada	1.4 (0.5)	0.8 (0.3)	2.7 (0.9)	2.0 (0.7)	0.9 (0.3)
Norway	12.1 (5.3)	19.3 (10.1)	20.7 (11.0)	14.7 (5.3)	9.6 (6.9)

* Standard deviations are in parenthesis

The empirical results demonstrate that Norway feels the larger impacts of its own monetary expansion on domestic variables. This country shows that its decrease in the policy rate triggers significant increases in macro variables, contributing to a boost in the economy. On the other hand, Canadian variables do not respond significantly to its own monetary shocks, failing to further economic activity. Monetary policy in Canada, in particular, appears not to stimulate people's long-term consumption and investment.

In section 3, I observed that nominal interest rates in Norway are not explained by their US counterpart as much as they are in Canada. Thus, this paper's empirical work may imply that long-term co-movement of a small open country's interest rate with the US rate limits the consequences of that country's monetary policy. That is, a fall in the policy rate may not be effective in invigorating the economy if the country's rates are highly correlated with the United States. To avoid inefficiency, the small open economy may be required to investigate more about its own policy effects and the US transmission channel.

5. Conclusion

In this paper, I have sought to provide a better understanding of co-movements among small open countries' yield curves and the efficiency of monetary policy. With the dynamic factor model, I analyzed movements and characteristics of common factors among the yield curves. In addition to this, I utilized a VAR model with exogenous variables to examine the impacts of monetary expansion.

First, by estimating the dynamic latent factor model, I found that small open economies' long-term interest rates are explained by their common factors more than short-term rates. The correlation between the common factor and the US counterpart increases alongside maturity, which is consistent with the fact that long-term nominal rates are closely related to the US counterpart. It is especially noticeable that Canada's rates and Norway's interest rates are better and less explained than others, respectively, by the US interest rates. I also found that policy rates are considerably correlated with the co-factor of short-term nominal rates, but not with that of mid- and long-term rates. From the estimation, I cast doubts on the influence of small open economies' monetary policies because long-term interest rates seem to divorce from the country's policy decision.

After this, I analyzed the impacts of monetary shocks in Canada and Norway, using a VAR model. I aimed to discover if the high long-term correlations between interest rates and the US rates would limit the power of a country's monetary policy. Calculating dynamic responses to a fall in the policy rates, I compared the policy effects of Canada and Norway in a numerical method. My empirical analysis shows that expansionary policy in Norway is much more efficient in stimulating the economy than in Canada. The decrease in Norwegian policy rate, in particular, was successful in inducing long-term consumption and investment while this was impossible in Canada. Since Canada is more related with the United States in terms of interest rates, this implies that the observed correlations with the United States may restrict the effectiveness of monetary expansion.

Appendix

1. Difference in lags

This section proves robustness of the dynamic latent factor model provided in Section 3. The tables below show various lags which can be applied to the same dynamic model. The tables describe the results of cumulative variance decomposition in the context of the shares of variance associated with the latent factors. As below, the difference in lags does not make significant changes in the study's results.

Table. Shares of variance accounted for by the common factor with lag 5

	Australia	Canada	Denmark	Norway	Switzerland	UK
SR						
1st	0.541	0.177	0.719	0.573	0.544	0.740
2nd	0.607	0.798	0.733	0.620	0.587	0.759
MR						
1st	0.147	0.192	0.633	0.337	0.563	0.134
2nd	0.849	0.841	0.819	0.652	0.800	0.785
LR						
1st	0.866	0.896	0.806	0.695	0.796	0.851
2nd	0.871	0.900	0.874	0.722	0.871	0.858

Table. Shares of variance accounted for by the common factor with lag 6 (same as Table1)

	Australia	Canada	Denmark	Norway	Switzerland	UK
SR						
1st	0.559	0.242	0.731	0.604	0.570	0.758
2nd	0.615	0.795	0.743	0.647	0.606	0.774
MR						
1st	0.846	0.836	0.762	0.577	0.733	0.789
2nd	0.854	0.845	0.830	0.650	0.798	0.796

LR						
1st	0.870	0.906	0.803	0.676	0.794	0.850
2nd	0.875	0.911	0.876	0.710	0.874	0.860

Table. Shares of variance accounted for by the common factor with lag7

	Australia	Canada	Denmark	Norway	Switzerland	UK
SR						
1st	0.274	0.795	0.108	0.204	0.206	0.239
2nd	0.616	0.806	0.729	0.633	0.588	0.763
MR						
1st	0.843	0.839	0.749	0.583	0.736	0.777
2nd	0.851	0.849	0.817	0.651	0.798	0.783
LR						
1st	0.867	0.906	0.794	0.681	0.788	0.843
2nd	0.872	0.910	0.871	0.713	0.871	0.852

Table. Shares of variance accounted for by the common factor with lag8

	Australia	Canada	Denmark	Norway	Switzerland	UK
SR						
1st	0.562	0.231	0.715	0.595	0.551	0.753
2nd	0.624	0.813	0.728	0.643	0.591	0.770
MR						
1st	0.167	0.216	0.634	0.334	0.558	0.142
2nd	0.849	0.845	0.821	0.647	0.797	0.784
LR						
1st	0.871	0.908	0.795	0.675	0.790	0.843
2nd	0.876	0.912	0.872	0.708	0.872	0.853

2. Identification

This section provides impulse responses of macro variables to the country's expansionary monetary policy in Canada and Norway. The descriptions below refer to the differed identification schemes I used for section 4. Figure6 and 7 depict the results for y, p, pc, r, m, xr, which show that the basic and extended systems are all reasonable.

1: $Y_t' = [y_t \ p_t \ \ pc_t \ r_t \ m_t \ \ x_t]$

2: $Y_t' = [y_t \ c_t \ p_t \ \ pc_t \ r_t \ m_t \ \ x_t]$

3: $Y_t' = [y_t \ i_t \ p_t \ \ pc_t \ r_t \ m_t \ \ x_t]$

4: $Y_t' = [y_t \ d_t \ p_t \ \ pc_t \ r_t \ m_t \ \ x_t]$

5: $Y_t' = [y_t \ dw_t \ p_t \ \ pc_t \ r_t \ m_t \ \ x_t]$

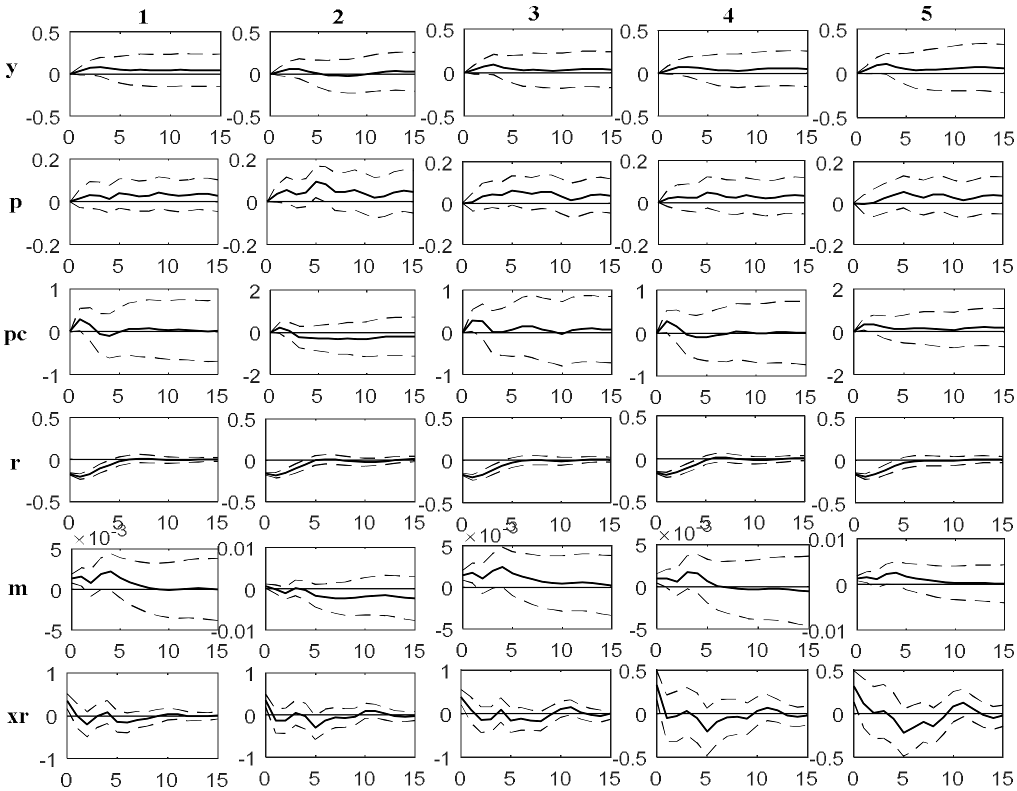

Figure6. Estimated impulse responses for extended identification schemes: Canada

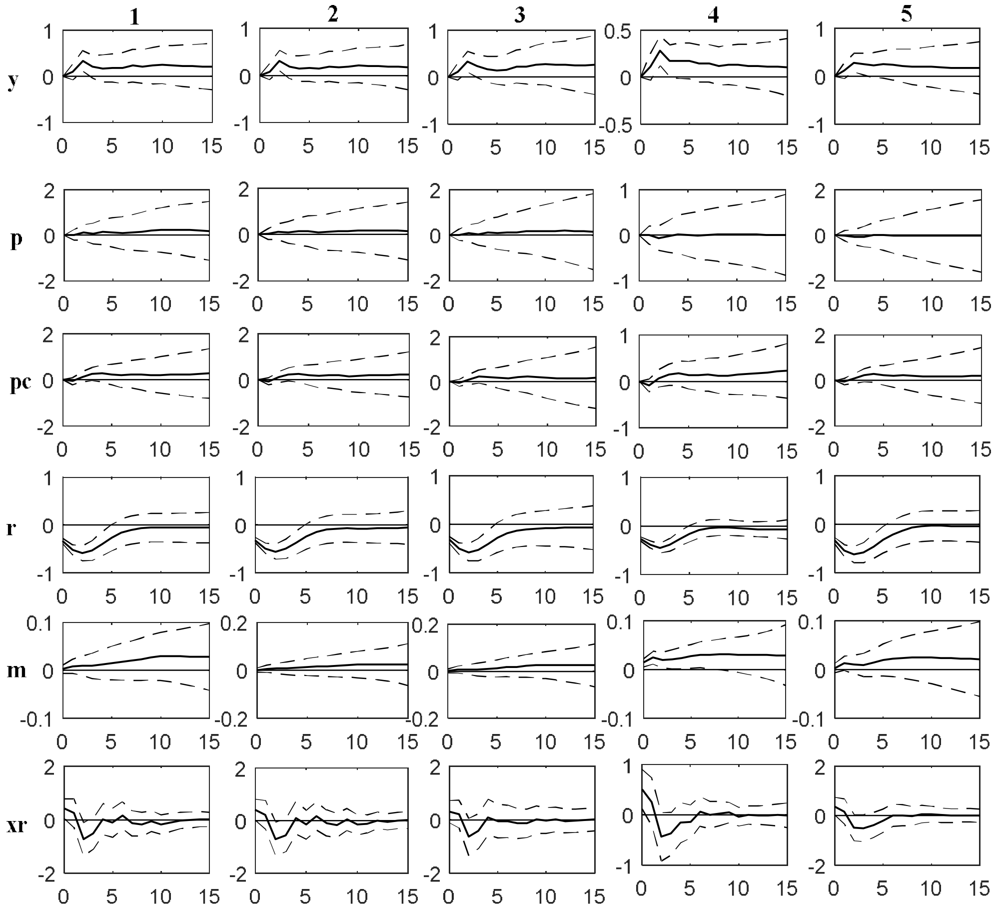

Figure7. Estimated impulse responses for extended identification schemes: Norway

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