Monetary policy and the transmission mechanism in Thailand

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Abstract

This paper studies the monetary transmission mechanism in Thailand. It examines the degree of pass-through from money market rates to retail rates, attempts to quantify the lags associated with monetary policy shocks, and investigates the channels through which these shocks are propagated. The empirical results point to a transmission mechanism in which investment is particularly sensitive to monetary shocks and banks act as an important conduit for monetary policy to real activity. They also suggest, however, that problems in the corporate and banking sectors may have undermined the monetary transmission mechanism over the last few years.

JEL classification: E40; E52; E58; E60

Keywords: Monetary policy; Transmission mechanism; Interest rate pass-through

1. Introduction

Understanding the transmission mechanism of monetary policy—especially the time lag involved between a policy change and its impact on inflation and output—is key to the successful conduct of policy. This paper attempts to improve our knowledge in this respect by addressing one key question: What are the stylized facts concerning the transmission of monetary policy in Thailand? With the emphasis on identifying the empirical regularities associated with monetary policy shocks in Thailand, the analysis carried out in this paper are of a positive rather than normative nature. We focus on what is rather than what should be.
How can monetary authorities influence the level of activity in the economy? There are a number of different but related channels through which changes in the stance of monetary policy affect the real economy. They include the traditional interest rate channel, the credit channel, the exchange rate channel, and the asset price channel. We will discuss each of these in turn and attempt to gauge their relative importance in Thailand. While the impact of monetary policy on the real economy and prices are determined by the monetary transmission mechanism taken as a whole, and by their respective importance, the regulatory framework of banking, as well as banking practices specific to each country and the structure of assets and liabilities also play a role in influencing the reactions of non-financial agents to interest rate changes. In addition, the degree of liquidity constraints related to bank practices influences the extent to which household and business expenditures are affected by monetary policy. For example, ceilings on indebtedness and large down-payment requirements hamper the ability of consumers to substitute between present and future expenditure, limiting the impact of changes in monetary policy on consumption. This constraint has been significant in Thailand as the consumer credit business has not really been developed until recently and, to a large extent, the desire by households to raise their spending when interest rates fall has been limited by their current earnings.

Our strategy for analyzing the transmission mechanism in Thailand is to first obtain a good quantitative assessment of the dynamic consequences of a change in the policy controlled interest rate on the main macroeconomic variables. Armed with these estimates, one could then gauge the overall impact of policy and attempt to disentangle the channels through which it takes place. In doing so, this paper relies heavily on the use of vector auto-regressions (VARs). These are dynamic systems of equations that examine the inter-relationships between economic variables, imposing minimal assumptions about the underlying structure of the economy, which—given the limited knowledge and lack of consensus about the transmission mechanism in Thailand—is a distinct advantage. VARs have also been used extensively to study monetary transmission in other countries so we can readily compare our results for Thailand with the international evidence.

The paper is organized as follows. We begin by examining the degree of pass-through from market interest rates to banks’ retail rates in Section 2, which—given Thailand’s heavy reliance on bank lending—constitutes a key element of the transmission mechanism. Results from our VAR analysis are then presented in Section 3. We start by estimating a simplified basic model, which is then extended to examine the sensitivity of different components of aggregate demand—private consumption, investment, exports, and imports—to monetary shocks. Next, we analyze the main channels through which monetary policy is transmitted to the real economy by comparing the output response to monetary shocks when successive channels of transmission are blocked off in the VAR, to the baseline response when the channel of interest is allowed to operate. Differences in the path of output gives an indication of the importance of that particular channel in acting as a conduit for monetary policy. Finally, we present a summary VAR that we feel captures the key elements of the transmission mechanism in Thailand. Section 4 concludes and some technical details are collected in an appendix.

1 A concise overview of the channels of monetary transmission is given by Mishkin (1996).
2 A brief technical summary of the VAR methodology is presented in Appendix A.
2. Interest rate pass-through in Thailand

A key dimension of the monetary transmission mechanism lies in the size and speed with which retail interest rates respond to changes in policy or money market interest rates. Retail rates are important because they represent the marginal cost of new credit as well as the opportunity cost of funds in the economy, especially in countries such as Thailand where non-bank sources of finance are still limited. We therefore begin our exploration of Thailand’s transmission mechanism by attempting to gauge the pass-through from money market rates (we use the 14-day repurchase rate, RP14) to bank lending minimum lending rate (MLR) and deposit (3-month fixed term) rates, and discuss possible sources of stickiness associated with movements in retail rates. To obtain a better sense of how sensitive retail rates in Thailand are to money market rates, the speed and size of the pass-through will be compared to those of other countries and their stability over time will also be examined by comparing the results from using the entire sample—from January 1989 to March 2002—with those obtained with data only up to December 1995. This should provide us with an indication of how the pass-through has been affected by the 1997 crisis.

We conduct our analysis using two methodologies—each with its own advantages—common in the literature, the dynamic multiplier method and the error correction model (ECM). The dynamic multiplier method, as popularized by Cottarelli and Kourelis (1994), involves estimating a simple dynamic model in which the relevant retail rate is regressed on lagged values of itself and a money market rate. The degree of pass-through is then measured by looking at the estimated impact of changes in money market rates on retail rates at different horizons (we focus on the impact, 3-month, 6-month, and the long-run multipliers). Since augmented Dickey-Fuller (ADF) tests indicate that all of our interest rate series are I(1), the regressions were run in first differences. One drawback of such a specification, however, is the loss of long run information about the level of the variables.

Our second estimation methodology overcomes this problem by incorporating the long-run information in the first difference regression through the use of cointegration techniques. The underlying idea is that non-stationary time series can drift apart in the short run, but are governed by a stable equilibrium relationship in the long-run. If variables are cointegrated, the relationship between them can be modeled through an error correction model. Since we cannot reject cointegration between each retail rate and RP14, we estimate the ECM using the two-step Engel-Granger procedure.

The results for the 3-month deposit rate are shown in Table 1. The immediate pass-through from RP14 to the 3-month deposit rate is quite low for both samples, with a 100 basis point rise in RP14 translating into less than a 6 basis point increase in the deposit rate. As the horizon becomes longer, however, it is apparent that the speed of pass-through has declined after the crisis, with the 3-month deposit rate adjusting in response to a 100 basis points change in RP14—by only around 43 basis points in the long run compared to 70

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3 We choose RP14 as our money market rate since it is a better predictor of retail rates than the overnight rate. In any case, the results were similar using the overnight rate.

4 The calculation for the multipliers is provided in Appendix A.2.

5 Since we are mainly concerned with the response of retail rates to changes in the money market rates (rather than the determinants of the level of retail rates), this problem is not too serious.
basis points in the pre-crisis sample. A clearer picture of how interest rate pass-through has changed over time can be obtained from the left hand panel of Fig. 1, which shows results from a series of rolling regression estimated using a 50-month moving window. While the impact multiplier has been relatively stable, the interim and long run multipliers has fallen with the inclusion of crisis year data. Finally, Table 1 also shows the results from the ECM model. While this methodology tends to give a lower degree of pass-through, they are generally in line with those from the multiplier method. Importantly, they confirm that the long run pass-through and speed of adjustment have indeed declined after the crisis.

Table 2 and the right-hand panel of Fig. 1 present the results from similar analysis using the MLR. For the pre-crisis sample, the impact multiplier is quite low at 8.9%, and long run pass-through of around 56% is again incomplete. The ECM regressions also suggest that the long run pass-through has declined along with the speed of adjustment. The latter points to

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Table 1
Pass-through to 3-month deposit rate

<table>
<thead>
<tr>
<th>Method</th>
<th>Period</th>
<th>Immediate</th>
<th>3-month</th>
<th>6-month</th>
<th>Long-run</th>
<th>Speed of adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic multiplier</td>
<td>1989M1–1995M12</td>
<td>0.057</td>
<td>0.402</td>
<td>0.612</td>
<td>0.700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1989M1–2002M3</td>
<td>0.059</td>
<td>0.317</td>
<td>0.399</td>
<td>0.429</td>
<td></td>
</tr>
<tr>
<td>ECM: Engel-Granger</td>
<td>1989M1–1995M12</td>
<td></td>
<td></td>
<td></td>
<td>0.500</td>
<td>0.147</td>
</tr>
<tr>
<td></td>
<td>1989M1–2002M3</td>
<td></td>
<td></td>
<td></td>
<td>0.350</td>
<td>0.070</td>
</tr>
</tbody>
</table>

The dynamic multiplier model was run with six lags. The ECM models were both estimated using four lags.

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Fig. 1. Interest rate pass-through.
a half-life of around 8 months for the whole sample, compared with just over 6 months using only pre-crisis data.\footnote{The half-life of a series refers to the amount of time needed for it to adjust half way to its long run equilibrium following a shock. It is calculated as \( \log(0.5)/\log(1 - s) \) where \( s \) is the speed of adjustment coefficient.} To get a better handle on Thailand’s interest rate pass-through, Table 3 presents the results for other countries obtained by Cottarelli and Kourelis (1994) using the dynamic multiplier method. Although the size and speed of the pass-through between 1989 and 1995 in Thailand is comparable to some countries such as Japan, Malaysia, and Finland, they are generally smaller and slower than most other developed countries.

Another dimension of interest rate pass-through concerns whether the effects are symmetric. That is, do retail rates respond to changes in the policy rate in the same way irrespective of whether the government is raising or lowering rates? For European countries, Mojon (2000) finds evidence of ‘interest rate cycle’ asymmetry where pass-through to lending rates is higher when interest rates are rising. Mester and Saunders (1995) also found that prime interest rates of US banks exhibit more stickiness in the downward direction. Borio and Fritz (1995), however, generally failed to detect significant differences in the response of retail rates to increases or decreases in interest rates in their examination of European data.

### Table 2
Pass-through to minimum lending rate

<table>
<thead>
<tr>
<th>Method</th>
<th>Period</th>
<th>Immediate</th>
<th>3-month</th>
<th>6-month</th>
<th>Long-run</th>
<th>Speed of adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic multiplier</td>
<td>1989M1–1995M12</td>
<td>0.089</td>
<td>0.328</td>
<td>0.521</td>
<td>0.558</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1989M1–2002M3</td>
<td>0.041</td>
<td>0.239</td>
<td>0.356</td>
<td>0.389</td>
<td></td>
</tr>
<tr>
<td>ECM: Engel-Granger</td>
<td>1989M1–1995M12</td>
<td></td>
<td></td>
<td>0.400</td>
<td>0.101</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1989M1–2002M3</td>
<td></td>
<td></td>
<td>0.356</td>
<td>0.080</td>
<td></td>
</tr>
</tbody>
</table>

The dynamic multiplier model was run with six lags. The ECM models were both estimated using four lags.

### Table 3
Results from Cottarelli and Kourelis (1994)

<table>
<thead>
<tr>
<th>Country</th>
<th>Impact</th>
<th>3 months</th>
<th>6 months</th>
<th>Long run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0.38</td>
<td>0.67</td>
<td>0.83</td>
<td>1.04</td>
</tr>
<tr>
<td>Australia</td>
<td>n.a.</td>
<td>0.35</td>
<td>0.67</td>
<td>0.81</td>
</tr>
<tr>
<td>US</td>
<td>0.41</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>UK</td>
<td>0.82</td>
<td>1.02</td>
<td>1.04</td>
<td>1.04</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.07</td>
<td>0.25</td>
<td>0.38</td>
<td>0.71</td>
</tr>
<tr>
<td>Finland</td>
<td>0.13</td>
<td>0.20</td>
<td>0.27</td>
<td>0.60</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.27</td>
<td>0.71</td>
<td>0.82</td>
<td>0.95</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.20</td>
<td>0.74</td>
<td>0.74</td>
<td>1.00</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.24</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.13</td>
<td>0.28</td>
<td>0.37</td>
<td>0.44</td>
</tr>
<tr>
<td>Japan</td>
<td>0.03</td>
<td>0.22</td>
<td>0.35</td>
<td>0.53</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.09</td>
<td>0.33</td>
<td>0.52</td>
<td>0.56</td>
</tr>
</tbody>
</table>

The table shows dynamic multipliers for measures of MLRs.
To see whether pass-through is symmetric in the case of Thailand, we follow Mojon (2000) in separating the sample according to interest rate cycle and compare estimates of the degree of pass-through between up- and down-cycles. Since pass-through appears to have declined generally after the crisis, we focus on the pre-crisis period where up- and down-cycles are more comparable. Using the dynamic multiplier method, we generally found the estimates to be similar across the cycle with, if anything, deposit rates appearing to be more rigid in the downward direction though not significantly so. We also cross-checked our results by running the regressions using the whole sample and including interaction dummies to distinguish between up- and down-cycles. The dummies were all generally insignificant and did not affect the original coefficient much confirming our earlier finding that pass-through appears to be symmetric in Thailand. However, political pressure against low deposit rates recently may have hampered adjustment of retail rates on the downward side but this should subside as the public comes to better understand the benefits of low interest rates from the macro perspective and their resistance to lower deposit rates is reduced.

2.1. Why are retail rates in Thailand relatively ‘sticky’?

Retail rates may be sticky for a number of reasons. First, informational asymmetries implies that raising bank credit rates may lead to a deterioration in the average creditworthiness of borrowers (due to adverse selection and moral hazard problems) and will not necessarily result in a proportionate increase in banks’ expected income. In addition, switching costs—associated with gathering new information—reduces the incentive for depositors and especially borrowers to change banks when others are offering better rates, allowing banks to hold-off on adjusting retail rates (Lowe & Rohling, 1992). At the same time, banks may be reluctant to pass on rate increases to its customers because they are wary of losing them along with established client-specific information which are costly to obtain. Thus, banks may be constrained by an implicit interest rate insurance, especially when they are investing in long-term relationships. Certainly in cases where borrowers prefer stable interest payments, a bank may charge a less variable interest rate than its marginal cost of funds for which it is compensated with a higher premium (Fried & Howitt, 1980). Finally, since money market rates contain a high level of ‘noise’ and given that there are adjustment costs to changing rates, banks may be prepared to do so only if they believe that movements in money market rates are durable.

These adjustment costs tend to be greater the less competitive the banking system is. From the Thai experience, it appears that financial liberalization in the early 1990s, which included the removal of interest rate ceilings and the establishment of the BIBF, resulted in a more competitive market structure that played a part in increasing the degree of interest rate pass-through. Looking forward, once remaining problems in the banking system are

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8 For the lending rate, the impact, 3-month, 6-month, and long-run multipliers during the upward interest rate cycle (1993:12–1995:05) were 0.02, 0.31, 0.37, and 0.51, respectively. The corresponding values during the downward cycle (1991:07–1993:11) were 0.11, 0.25, 0.35, and 0.56, respectively. With respect to deposit rates over the same time period, the impact, 3-month, 6-month, and long-run multipliers during the upward interest rate cycle were 0.13, 0.31, 0.38, and 0.70, respectively. The corresponding values during the downward cycle were 0.10, 0.21, 0.34, and 0.49, respectively.
sorted out, the trend towards increased competition should resume and bring about a higher degree of sensitivity of retail rates to money market rates.

In summary, the evidence in this section indicates that interest rate pass-through in Thailand is generally lower than those in developed countries. Moreover, the sensitivity of retail rates to money market rates appear to have declined in the aftermath of the 1997 financial crisis, undoubtedly a by-product of unresolved banking sector problems and high liquidity in the system, as well as the changing competitive landscape associated with a smaller number of active financial institutions and less capital inflow. We also find that the 3-month deposit rate is generally more responsive to changes in RP14 than the MLR, most likely a reflection of the fact that the market for deposits is more competitive with lower switching costs.9 With this in mind, we now turn to more direct analysis of the monetary transmission mechanism.

3. VAR results

3.1. Basic model

We start our VAR analysis with a small basic model which includes real output (GDP), the CPI (PRICE), and the 14-day repurchase rate (RP14).10 The latter is our measure of monetary policy. In addition to a constant term, the VAR also contains the Baht/US exchange rate as an exogenous variable to control for the 1997 crisis.11 The estimation is done using quarterly, seasonally adjusted data from 1993Q1 to 2001Q4 with two lags. While the optimal lag length under various criteria (including the Akaike, Schwarz, and Hannan-Quinn criteria) appears to be one quarter, we feel that this is too short to capture the underlying dynamics of the system. At the same time, we quickly run into degree of freedom problems if we include too many lags. For this reason, the VARs estimated in this paper are quite parsimonious with the set of variables kept relatively small and lag length set to two quarters. In any case, the results are similar with only one lag.12

The VAR is identified using a ‘recursive’ Choleski decomposition with the ordering of variables as listed above.13 The ordering reflects an implicit assumption about the dynamic structure of the economy and is in part guided by the fact that movements in RP14 tend to lead changes in GDP. In particular, the conjecture is that GDP is not affected contempor-

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9 The faster response of deposit rates may also reflect the tendency of banks to adjust first those asset and liabilities which are closest to the source of shock in terms of maturity.
10 The VARs were also estimated using private demand (real GDP minus total government spending, which is primarily driven by fiscal policy) instead of GDP but the results are almost identical. Similarly, the results in this paper are robust to the inclusion of oil or world commodity prices to capture supply shocks, as well as to the inclusion of the Fed Funds Rate to reflect developments in world interest rates. All variables except RP14 are in logs.
11 This seems to be able to capture the large residuals associated with the crisis and is more satisfactory, from an economic point of view, than including a crisis dummy.
12 Generally speaking, lag length criteria such as the Akaike and Schwartz statistic are not without shortcomings and should be used more as a guide than hard-fast rules. Ramaswamy and Sloek (1997) also used two lags in their cross-country comparison of monetary transmission in the EU, as did Bayoumi and Morsink (2001) in their analysis of Japan.
13 See Appendix A for a description of alternative identifying schemes.
aneously by shocks to other variables in the system while RP14 responds to innovations in GDP and PRICE within the same period. This reflects an assumption about the speed with which the variables respond to shocks with output being the least responsive, followed by prices, and finally interest rates. This seems plausible and consistent with actual behavior of the economy since changing output and prices are time-consuming processes while monetary authorities set policy with at least some indication about contemporaneous developments in output and prices. In any case, the results are fairly robust to alternative ordering, including some radical ones such as completely reversing the order.

At the outset, it is useful to examine whether the monetary policy shocks identified by our VAR seem reasonable. Fig. 2 plots the recovered structural RP14 innovations against the quarter-on-quarter growth of RP14, where positive innovations in RP14 are identified with monetary policy tightening while negative values represent episodes of loosening. The graph indeed shows that positive structural innovations are generally associated with increases in the RP14 rate while negative innovations with declines, as one would expect.

We now turn to the impulse response functions from the basic model, which are presented in Fig. 3.14 These basically traces out the implied dynamic paths of the endogenous variables in the system following a one-time shock to one of the innovations. They allow us to ‘see’ the monetary transmission mechanism unfolding by illustrating the response of the system to a shock in our measure of monetary policy. An unexpected tightening of monetary policy—corresponding approximately to a 2% rise in RP14—gives rise to a U-shaped output response which bottoms out after around 4–5 quarters (at 0.82% below baseline) and dissipates after 12 quarters. Prices do not begin to decline until about six quarters, and although the fall itself is quite small (around 0.23% below baseline at

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14 All impulse responses in this paper are based on one standard deviation innovations in the variable of interest.
Fig. 3. Basic model.
the maximum), it seems quite persistent. Finally, the interest rate shock is also quite persistent, taking around six quarters to dissipate.\textsuperscript{15}

The initial positive response of prices to a contractionary monetary policy shock seems somewhat contradictory, but is commonly found in the literature and has been dubbed the ‘price puzzle’. A leading explanation is the failure to include a rich enough specification of the information available to policymakers. If policy makers can observe variables that contain useful information about future inflation, but those variables are left out of the model, then positive innovations in interest rates may be associated with higher prices because they partly reflect systematic policy responses to information indicating that inflation is on the way. As will be shown below, the inclusion of bank credit can effectively remove the price puzzle in the case of Thailand.

To get an idea of the share of the fluctuations in a given variable that are caused by different shocks, Table 4 presents variance decompositions for each variable at forecast horizons of one through four years. The columns give the percentage of the variance due each shock, with each row adding up to 100%. The results indicate that, after two years, interest rate shocks account for around 35% of the fluctuation in output, with own shocks accounting for most of the rest. This is similar to empirical results for the US and indicate that interest rate innovations are an important determinant of fluctuations in economic activity.

<table>
<thead>
<tr>
<th>Period</th>
<th>GDP</th>
<th>PRICE</th>
<th>RP14</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>73.30</td>
<td>5.15</td>
<td>21.56</td>
</tr>
<tr>
<td>8</td>
<td>58.23</td>
<td>5.91</td>
<td>35.86</td>
</tr>
<tr>
<td>12</td>
<td>56.10</td>
<td>8.05</td>
<td>35.85</td>
</tr>
<tr>
<td>16</td>
<td>55.90</td>
<td>8.47</td>
<td>35.63</td>
</tr>
</tbody>
</table>

\textsuperscript{15} Using the same recursive identification scheme adopted in this paper, Ramaswamy and Sloek (1997) find that transmission of monetary policy shocks in the EU countries fall into two main groups. In one group (Austria, Belgium, Finland, Germany, The Netherlands, and the UK) output bottoms out approximately 11–12 quarters following a contractionary monetary shock, with the decline in output amounting to around 0.7–0.9% from the baseline. In the other group (Denmark, France, Italy, Portugal, Spain, and Sweden) output typically bottoms out about 5–6 quarters following a contractionary impulse, with the decline in output being in the range of 0.4–0.6% from baseline. In all cases, the monetary shock corresponds approximately to a 1% point shock to the interest rate.
Finally, it is important to note that when the VAR was re-estimated using data up to only 1999Q1, the output and price response is larger. In response to an interest shock of roughly the same size, trough output is 1.2% below baseline after four quarters, while prices decline by 0.28% at the maximum. This gives an indication of the extent to which the effectiveness of monetary policy has been reduced in recent years by structural problems relating particularly to difficulties in the banking and corporate sectors. We will revisit this issue in more detail below in our analysis of the different channels of monetary transmission.

3.2. Components of aggregate demand

The basic VAR is now extended to examine which components (private consumption, investment, exports, and imports) of real GDP are most affected by monetary policy. This is accomplished by re-estimating the basic model with real GDP split into the particular component being examined and the remainder. For example, to analyze the response of exports, the VAR includes GDP less exports, exports, PRICE, and RP14. Fig. 4 shows the response of the individual components of GDP to an RP14 shock. The graphs are plotted on the same scale and in all cases, the monetary shock amounts to roughly a 1.7% rise in the RP14 rate.

Fig. 4. Components of aggregate demand.
The results indicate that monetary policy operates on the real economy largely through its impact on investment. A typical innovation in the RP14 lowers investment quite steeply, bottoming out after five quarters at around 2.5% below baseline. By contrast, at its trough, consumption is only slightly over 1% lower than baseline after five quarters.\textsuperscript{16} The response of imports largely mirrors those of consumption and while exports do decline eventually, in line with an exchange rate channel story, the effect is quite small and dissipates quickly. The latter is not entirely unexpected given that for much of the sample, Thailand was operating under a fixed-exchange rate regime. While the importance of investment is consistent with the traditional channel of monetary transmission—higher interest rate leading to lower investment demand—it is also suggestive of the presence of a significant bank lending channel since investment in Thailand has historically relied heavily on bank credit, at least at the margin. It is directly to these issues that we now turn.

3.3. Channels of monetary transmission

We gauge the strength of each channel by first appending the basic model with a variable that captures the particular channel of interest and calculating two sets of impulse responses: one with the variable treated as endogenous in the VAR and another where it is included as an exogenous variable. The latter procedure generates a VAR identical to the former (with identical orthogonalized innovations), except that it effectively blocks off any responses within the VAR that passes through the variable of interest. Comparison of the output responses of the two models thus provides a measure of the importance of that particular channel in acting as a conduit for monetary policy to the real economy.\textsuperscript{17}

Before turning to the results, we should note that to really get a good grip on the importance of each channel of transmission, one would have to study each in detail, ideally making use of micro-data (for example as in Kashyap and Stein (1997) for the US) such as corporate flow of funds data. Given the data constraints for Thailand and the focus on documenting stylized facts about monetary transmission, this paper adapts the VAR methodology to obtain rough indications of the relative importance of each channel. Once the picture becomes clearer and key elements of the ‘black box’ identified, further research can be conducted to more systematically uncover the factors responsible for making one channel more important than the other in the case of Thailand.

3.3.1. Bank lending channel

We begin by examining the role of bank credit. The so called ‘bank lending channel’ operates through the fall in bank reserves brought on by a contractionary monetary policy, implying a lower supply of loanable funds that can be used to finance investment and consumption. In contrast to the traditional ‘money view’, bank loans and bonds are considered imperfect substitutes. Monetary policy may have amplified effects on aggregate

\textsuperscript{16} Barran, Coudert, and Mojon (1996) also find for the EU countries that monetary shocks affect aggregate demand primarily through its impact on investment.

\textsuperscript{17} Bayoumi and Morsink (2001) applied a similar method in their analysis of the Japanese monetary transmission mechanism.
demand by modifying the availability or the terms of new loans. The lending channel presumes that small and medium-sized firms, facing informational frictions in financial markets, rely primarily on bank loans for external finance because it is prohibitively expensive for these borrowers to issue securities in the open market. The importance of this channel thus depends on two factors: (i) the degree to which the central bank can affect the supply of bank loans; and (ii) the dependence of borrowers on bank loans. These factors are clearly influenced by the structure of the financial system and its regulation.

The key point here is that the real effects of higher interest rates may be amplified through the lending channel beyond what would be predicted were policy transmitted solely through the traditional interest rate (cost of capital) channel. As market interest rates rise subsequent to monetary tightening, business investment falls not only because the cost of capital is higher, but also because the supply of bank loans, mostly to small and medium-sized firms, is reduced.

Historically, firms in Thailand have relied heavily—perhaps excessively—on bank lending. This is reflected in Fig. 5, which shows that Thailand’s credit to GDP ratio is high by emerging market standards. The bias towards bank debt-financing not only makes firms more dependent on bank lending, but also increases the sensitivity of firms’ balance sheets to interest rate movements. An indication of monetary policy’s impact on firms’ balance sheets is presented in Fig. 6, which shows the response of the ratio of interest expenses to total assets of Thai firms to a contractionary monetary shock. 18 Evidently, a rise in the RP14 immediately translates into higher interest expenses for firms as a ratio of total assets, which peaks after two quarters. 19

To examine the role of bank loans in the transmission mechanism, we append the basic VAR model with the log of bank credit (LOANS). 20 The VAR thus comprises of GDP,
PRICE, RP14, and LOANS. Fig. 7 shows the impulse responses of GDP, bank credit, and prices to innovations in RP14 and bank credit. Two things are directly noticeable. First, the output response to RP14 shocks (of roughly 2%) is now larger than in the basic model but the effects dissipate faster. Second, the ‘price puzzle’ has disappeared with prices hardly moving until about a year then declining to a bottom after roughly 10 quarters. In addition, GDP and prices respond positively to innovations in bank lending, while loans eventually fall following a monetary shock with the maximum response occurring after about seven quarters. The latter is consistent with what one would expect since loans are quasi-contractual commitments whose stock is difficult to change quickly and also with the evidence for the US economy (see Bemanke & Blinder, 1992). Finally, a variance decomposition (not shown) reveals that the share of output variance accounted for by RP14 is now larger at around 50% after two years reflecting the more prominent role of monetary policy in the augmented model.

The importance of banks in transmitting monetary shocks to the real economy can be gauged by exogenizing bank loans in the calculation of the impulse responses. As shown in the left-hand panel of Fig. 8, the output responses to an RR14 shock with and without LOANS exogenixed are quite similar for the first four quarters but the former dissipates more quickly thereafter. But while the output response is indeed dampened when the role of bank credit is blocked off, the difference is not very pronounced indicating the existence of a bank lending channel that is not very strong. Indeed, after two years, the accumulated response of output is only around 16% lower when this channel is blocked off.

The orthogonal shocks to credit can be considered as shocks to credit supply since changes in credit attributable to demand effects is already captured, to a large extent, by lagged and contemporaneous changes in GDP.
Fig. 7. Bank lending model.
Fig. 8. The bank lending channel.
This may seem surprising given the importance of banks in the Thai financial system. A possible explanation is that in the aftermath of the crisis, the role of banks in financing real activity has been hampered by structural problems relating to non-performing loans and a weakened capital base. Indeed, the decline in banks’ intermediary role is evident in the middle panel of Fig. 8 which shows that before and immediately after the 1997 crisis, real activity and real bank loans tracked each other quite closely. However, since 1999 real output has recovered while real credit has continued to decline (until very recently). This reduction in the credit-intensity of production suggests that firms have increasingly turned to other sources of non-bank financing, such as retained earnings and corporate bond issues. Indeed, the right-hand panel of Fig. 8 shows that corporate bond issues have risen sharply as GDP began to recover in 1999 and remains above past levels.

To verify whether these casual observations stand up to more rigorous analysis, we re-estimate the VAR using data only up to the first quarter of 1999. The differences are stark. The first two panels of Fig. 9 display the responses of GDP and bank credit to innovations in RP14 and LOANS estimated using the truncated sample. Compared to the results in Fig. 7, it is evident that the impact on output and bank credit of a similarly sized monetary policy shock is significantly more pronounced in the model estimated using data only up to 1999Q1.22 Similarly, innovation in bank credit unrelated to interest rates increases output by more in the sub-sample. This suggests not only that the effectiveness of monetary policy has declined since 1999 but also that this decline has been associated with a weaker bank lending channel. Indeed the right-hand panel of Fig. 9 confirms that the degree with which the response of output to monetary shocks is dampened when bank loans are exogenized is considerably larger over the sample from 1993Q1 to 1999Q1. After four quarters, nearly half of the direct impact of a change in the RP14 rate on GDP comes through bank loans. The weakening of the bank lending channel recently has apparently been driven by a smaller sensitivity of both bank loans to monetary policy and of output to bank loans.

Looking forward, there are two sets of opposing forces that will determine the strength of the bank lending channel. On the one hand, resolution of remaining banking sector problems and continued expansion of consumer credit should alleviate supply side constraints and increase the importance of bank loans in the economy. On the other hand, reliance on bank-finance should decline as capital markets become more developed, while banks are likely to strengthen their ability to cushion any fall in bank reserves and retail deposits associated with a tightening of policy, thereby reducing the sensitivity of loans supply to monetary shocks. Nonetheless, given that fundamental capital market development tends to take place gradually and the continued importance of small firms in Thailand, the overall effect in the medium term should be an increase in the significance of the bank-lending channel.

3.3.2. Exchange rate channel

For small open economies, a potentially important channel through which monetary policy may affect real activity is through its effects on the exchange rate. Specifically, a nominal depreciation brought on by monetary easing, combined with sticky prices, results

22 Trough output response is about 1.3% below baseline in the full model compared to around 2% in the model estimated over the sub-sample. Similarly, loans bottoms out at around 2.7% below baseline in the shorter-sample model compared to 1% in the full-sample model.
Fig. 9. Pre-crisis bank lending channel.
in a depreciation of the real exchange rate in the short-run and thus higher net exports. The strength of the exchange rate channel depends on the responsiveness of the exchange rate to monetary shocks, the degree of openness of the economy, and the sensitivity of net exports to exchange rate variations. However, substantial unanticipated exchange rate depreciations can actually reduce output when a significant share of debt in the economy is foreign currency denominated.\footnote{Disyatat (2001) presents a model which highlights this trade-off and relates the output effects of a depreciation to the health of the banking system.}

To examine the role of exchange rates in the Thai monetary transmission mechanism, we add the log of the real effective exchange rate (REER) to our basic VAR model.\footnote{Note that we exclude the Baht/US exchange rate from the VAR in this section since most of the information is already contained in the real exchange rate index.} Fig. 10 shows the response of output to innovations in RP14 with and without the real exchange rate exogenized. With the exchange rate channel blocked off, we do find that the output response is dampened somewhat with the trough output being around 0.5% of baseline higher than the case with the exchange rate endogenous. In terms of accumulated responses, the total impact on output with this channel blocked off is around 19% lower after 2 years.\footnote{Clements, Kontolemis, and Levy (2001) also find that the exchange rate channel in the Euro-area countries is relatively small and attribute the result to weak responses of output to movements in the effective exchange rate.}

These results should be viewed with some caution, however, since the exchange rate regime was modified during the sample period and also because the regime switch was associated with substantial non-linear movements in the exchange rate. A priori, one would expect the move from a fixed to floating exchange rate regime to enhance the importance of the exchange rate channel for the simple reason that nominal exchange rates are not allowed to fluctuate in the former case. Real exchange rates, however, can vary under a pegged regime so there is scope for monetary policy to affect real activity through this channel but the effects are likely to be muted given that prices adjust slowly.
To verify this intuition, Fig. 11 shows the response of output to innovations in RP14 with and without the real exchange rate exogenized estimated using only post-crisis data. Evidently, blocking off the exchange rate channel greatly dampens the output response (much more so compared to results using the whole data set). However, given the small number of observations, the standard errors are also a lot wider making it difficult to draw firm conclusions from these estimates. Nevertheless, it does suggest that exclusion of data from the fixed exchange rate period tends to increase the significance of the exchange rate in propagating monetary shocks. Looking forward, the exchange rate channel may become more prominent as the flexible exchange rate regime becomes fully entrenched and a more accurate estimates can be obtained once more data from the flexible exchange rate period is accumulated.

3.3.3. Asset price channel

Another potential conduit of monetary policy shocks are fluctuations in asset prices. A monetary easing can boost equity prices by making equity relatively more attractive to bonds (since interest rates fall) as well as improving the earnings outlook for firms (since household spending rises). Higher equity prices, in turn, can propagate monetary impulses in two main ways. First, higher equity prices increases the market value of firms relative to the replacement cost of capital, also known as Tobin’s $q$, spurring investment. Secondly, increases in stock prices translates into higher financial wealth of households and therefore higher consumption. In addition, to the extent that higher equity prices raises the net worth of firms and households and improve their access to funds, the effects captured would partly reflect the ‘balance sheet channel’ of monetary policy as well. Note that the notion of equity here can also be expanded to encompass a broader range of assets, such as real estate. However, due to data limitations we will limit our attention only to stock market equity, keeping in mind that these may serve as a proxy for a broader range of assets as well.

To examine the role of asset prices in the Thai monetary transmission mechanism, we add the log of the SET index to our basic VAR model. Fig. 12 shows that a monetary
Fig. 12. Asset price channel.
tightening (corresponding to a rise in the RP14 rate of around 2%) results in an immediate but small fall in equity prices of approximately 4% that lasts about six quarters, while innovations in asset prices boost output as expected. The latter effect is relatively small, however, with a 16% innovation in stock prices boosting output by only at most 0.4% from the baseline. Not surprisingly, exogenizing the stock index dampens the response of GDP only slightly as depicted in the right-hand panel of Fig. 12. Comparing the accumulated responses indicates that movements in equity prices accounts for only around 17% of the total impact on output after 2 years.

The relative unimportance of asset prices in transmitting monetary shocks is not entirely surprising given that share ownership is not yet very pervasive in Thailand, and that firms’ reliance on equity financing has not been very significant compared to bank credit. No doubt the role of asset prices in the transmission mechanism should increase into the future in line with continued developments in capital markets that both increases investment opportunities for households, as well as financing options for firms.

3.3.4. Direct interest rate channel

Having discussed more sophisticated ways in which monetary policy affects real activity, we now go back to basics and examine the direct interest rate effects of monetary shocks. This traditional channel of monetary transmission associates a monetary easing with falls in real interest rates (since prices are sticky in the short-run) that causes interest-sensitive components of aggregate demand, such as investment spending, to rise which ultimately results in higher output. With the relatively high degree of leverage in Thailand and much of bank debt at floating rates, our priority is that the interest channel should be quite important.

The interest rate channel can be proxied by the residual output effects after blocking off each of the other channels respectively. As a preliminary estimate, our previous results indicate that in terms of accumulated responses, the three channels (bank lending, exchange rate, asset price) together account for around half of the output response after two years, leaving the remaining half to be explained by the interest rate channel. To obtain a more direct measure, we augment our basic VAR by including bank loans, the real exchange rate index, and the SET index and compare the output responses with and without these variables exogenized. The results in Fig. 13 generally confirm our initial estimate, indicating that the traditional channel accounts for roughly half of the output effect after four quarters, and moreover that variations in the other three variables play a role in hastening the dissipation of monetary policy shocks.

3.4. Summary model

Taking stock of our findings, we now construct a single VAR that summarizes the key aspects of the monetary transmission mechanism in Thailand, namely the importance of bank lending, and the particular sensitivity of investment and consumption (relative to other components of aggregate demand) to monetary shocks. The summary VAR thus contains investment, consumption, prices, RP14, and bank credit (in that order). The impulse responses are displayed in Fig. 14.
Fig. 13. The traditional interest rate channel.

Fig. 14. Summary model.
Monetary shocks, equivalent to an increase in the RP14 of approximately 1.8%, lead to substantial declines in investment which bottoms out after four quarters at around 3.3% below baseline. In contrast, the consumption response is smaller and reaches its trough much quicker, 1.2% below baseline after two quarters. Consumption appears, however, to remain near its trough for longer. The finding that investment responds more gradually is consistent with the idea that planning processes for investment are longer than for consumption. The response of prices is quite slow, declining only after about a year and reaching a trough after 10 quarters at around 0.3% below baseline. The gradual and relatively small response of prices is consistent with evidence from other countries (see Christiano, Eichenbaum, & Evans, 1998; Mojon & Peersman, 2001). In line with the existence of a bank lending channel, bank loans decline after three quarters to a trough of 1.3% below baseline after seven quarters. In addition, shocks to bank credit raises investment but has only a negligible impact on consumption, suggesting that the bank-lending channel works mainly by constraining investment rather than consumption. This is confirmed in Fig. 15, which shows that exogenizing bank loans does indeed have more of an impact on the response of investment than consumption. The latter partly reflects the lack of development of the consumer credit sector with Thai households being relatively under-leveraged.

### 3.5. Specification issues and robustness

Given that our sample space is not that long and includes some turbulent periods, it is important to check our results for robustness and also look for evidence of structural breaks and other misspecification problems in the VAR. First, given the relatively small number of observations, we checked the robustness of our results by

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26 While the magnitudes are not very different, loans seem to play a role in prolonging the output effect by drawing out the investment response.
running the VAR on monthly data from 1989M1 to 2001M12 using the manufacturing production index (MPI) as our proxy for real GDP and found not only that the shape, but also the timing, of the impulse responses were broadly similar. Fig. 16 shows the response of MPI to an RP14 innovation in a model that includes MPI, CPI, RP14, and bank credit estimated using six lags. A contractionary monetary policy leads to declines in the MPI, which bottoms out after around 12 months and dissipates after 30 months.

In terms of stability, Fig. 17 shows the cumulative sum of squares (CUSUM) tests for parameter stability as well as the recursive residuals for each equation of the VAR in the basic model. The results indicate that despite some minor episodes of instability, the residual variance of each equation is generally stable (the test statistics remain within the 5% critical band). Moreover, the inverse roots of the characteristic polynomial all have modulus less than one and lie inside the unit circle indicating that the estimated VAR is stable (stationary). We also carried out the multivariate LM test for residual serial correlation up to four lags and could not reject the null of no serial correlation for all cases.

Finally, given that some of the variables in the model are likely to be non-stationary, there is a trade-off between estimating the VAR in levels versus in first differences. The trade-off is between the loss of efficiency (when the VAR is estimated in levels) and the loss of information about long-run relationships (when the VAR is estimated in first differences). In particular, a VAR in first differences provides no information on the relationships between levels of the variables in the VAR, and it is this aspect on which economic theory is usually most informative. Moreover, while estimation in levels may incur some efficiency losses, this comes at no cost in terms of consistency of estimators. Most of the empirical literature on VARs have tended to estimate VARs that are unrestricted in levels. We have done the same here.
Fig. 17. Stability tests.
4. Conclusion

The goal of this paper has been to enhance our understanding of the monetary transmission mechanism in Thailand. In light of data constraints and the limited number of studies on the subject, our goal has been relatively modest but at the same time focused. Specifically, we have attempted to quantify the lags associated with monetary policy shocks and investigate the channels through which these shocks are propagated. In doing so, we have unearthed a set of key findings that can be summarized by the following stylized facts about the response of the economy to a tightening of monetary policy:

Stylized fact 1: The aggregate price level initially responds very little, but starts to decline after about a year and quite persistently so.

Stylized fact 2: Output follows a U-shaped response, bottoming out after around 4–5 quarters and dissipating after approximately 11 quarters.

Stylized fact 3: Investment appears to be the most sensitive component of GDP to monetary policy shocks.

These observations are generally consistent with findings in other countries, using similar methodology, including the US and European countries.

Moreover, in addition to the traditional interest rate channel, the results in this paper point to a transmission mechanism in which banks play an important role. The exchange rate and asset price channels have been less significant by comparison. Together with our finding that interest rate pass-through in Thailand is generally lower than those in developed countries, the results suggest that banks partly respond to changing liquidity conditions through the adjustment of both the price and quantity of loans (i.e. credit rationing). In this respect, it appears that interest rates alone do not adequately reflect the links between financial markets and the rest of the economy. Rather, developments in quantity variables, such as credit and money supply, contain useful information about output trends that should be monitored closely.

Nevertheless, the role of bank lending appears to have declined in the past 3 years along with the sensitivity of retail rates to money market rates. This has taken place in conjunction with the rise in prominence of non-bank sources of finance and continued weaknesses in the banking sector. To the extent that the latter has acted as a constraint on new bank credit, it would have tended to offset the impact of monetary easing. In addition, by effectively limiting investment demand, excess capacity and balance sheet weaknesses in the corporate sector have also blunted both the bank lending and traditional interest rate channels.

Overall, the picture that emerges is one in which a monetary easing leads first to a pickup in domestic demand, primarily investment demand financed by bank lending, which translates into a gradual build up of price pressures that eventually moves the overall price level with a significant lag. Looking forward, restoration of the banking system to full health and effective de-leveraging of corporate sector balance sheets are essential steps in unclogging the wheels of the transmission mechanism and improving the effectiveness of monetary policy. At the same time, retail rates that are more sensitive to money market conditions would remove an important impediment in the financial system. Moreover, as households diversify their portfolios more towards bonds and
equities, the asset price channel of monetary transmission should strengthen as wealth effects become more important.

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Appendix A

A.1. VAR methodology

VARs are dynamic systems of equations in which the current level of each variable in the system depends on past movements in that variable and all other variables in the system. In contrast to other macro-econometric models (including the BOT’s model), VARs make few assumptions about the underlying structure of the economy and instead focus entirely on obtaining a good statistical representation of the past interactions between economic variables, letting the data determine the model. However, VARs are not completely devoid of assumptions since the choice of variables, lag length, and identification scheme can have important implications on the outcome. Nevertheless, VARs attempt to characterize the economy making a minimum number of a priori assumptions.

The basic premise is that the economy is described by a linear, stochastic dynamic system of the following form

\[ Y_t = B_0 Y_t + B_1 Y_{t-1} + \cdots + B_p Y_{t-p} + \varepsilon_t, \]  
(A.1)

where \( Y_t \) is an \( n \times 1 \) vector of variables in the system at time \( t \), \( B_i \) for \( i = 0, \ldots, p \), are \( n \times n \) matrix of coefficients, and \( \varepsilon_t \) an \( n \times 1 \) vector of structural shocks with a variance-covariance matrix of \( E(\varepsilon_t \varepsilon'_t) = I \). The VAR estimates (A.1) in the reduced form

\[ Y_t = A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + u_t, \]  
(A.2)

where \( u_t \) is the \( n \times 1 \) vector of residuals with variance-covariance matrix \( E(u_t u'_t) = \Omega \).

Defining \( A_0 = (I - B_0)^{-1} \), implies that \( A_i = A_0 B_i \), for \( i = 1, \ldots, p \). The structural shocks and the reduced-form residuals are thus related by

\[ u_t = A_0 \varepsilon_t, \]  
(A.3)

so that

\[ \Omega = A_0 \Omega A'_0. \]  
(A.4)
To obtain the impulse response functions, write (A.1) and (A.2) in MA form respectively as

\[ Y_t = [I - B(L)]^{-1} \varepsilon_t, \]  
(A.5)

and

\[ Y_t = [I - A(L)]^{-1} u_t. \]  
(A.6)

From (A.3), the impulse response to structural shocks can be obtained from (A.5) and (A.6) using the relation

\[ [I - B(L)]^{-1} = [I - A(L)]^{-1} A_0. \]  
(A.7)

While the elements of \( A(L) \) can be obtained directly from the regression, not all of the \( n^2 \) elements of \( A_0 \) are identified without the imposition of further assumptions. These so-called ‘identifying assumptions’ are necessary to recover the structural shocks, \( \varepsilon_t \), from the reduced-form residuals, \( u_t \). The variance-covariance matrix obtained from the estimation provides, through (A.4), \( n(n + 1)/2 \) restrictions on \( A_0 \), leaving \( n(n - 1)/2 \) additional restrictions required for full identification. There are four general approaches that have been used in the literature to obtain identification, namely: (i) restrictions on the contemporaneous effects of shocks through \( A_0 \); (ii) restrictions on the contemporaneous relations of variables through \( B_0 \); (iii) long-run restrictions through \( A(1) \) or \( B(1) \); and (iv) some combination of these three identification schemes.

The literature has not yet converged on a particular set of assumptions for identifying the shocks although there is broad agreement about the qualitative effects of monetary policy shocks as the results appear robust across a large subset of identification schemes.27

This paper adopts the standard and widely used recursive identification scheme which corresponds to assuming that \( A_0 \) is lower triangular and is implemented through the Choleski decomposition of the matrix \( \Omega \). The recursivity assumption translates into assumptions about the contemporaneous effects of shocks implicit in the ordering of the variables in the VAR. Specifically, the variable that comes first is most exogenous in the sense that it does not react to contemporaneous shocks to the other variables in the system while the variable ordered last responds to not only own shocks but also shocks to every other variable in the system. After the contemporaneous period is over, the response is again unrestricted.

A.2. Dynamic multiplier calculations

The dynamic multiplier model involves estimating

\[ i_t = \sum_{j=1}^{n} \gamma_{j} i_{t-j} + \sum_{j=1}^{m} \beta_{j} m_{t-j} + u_t, \]  
(A.8)

27 Christiano et al. (1998) provides a nice overview of the extensive VAR literature and the various identification schemes employed.
where \( i_t \) and \( m_t \) are the relevant retail and money market rate, respectively. Using the lag operator, (A.8) can be written as

\[
(1 - \alpha_1 L - \alpha_2 L^2 - \cdots - \alpha_n L^n) i_t = (\beta_0 + \beta_1 L + \beta_2 L^2 + \cdots + \beta_p L^p) m_t + u_t,
\]

or

\[
i_t = \frac{B(L)}{A(L)} m_t + \frac{u_t}{A(L)}.
\]

The effect on \( i_{t+j} \) of changes in \( m_t \) is given by

\[
\delta_j = \sum_{i=1}^{\min(j,n)} \alpha_i \delta_{j-i} + \beta_j \quad \text{for} \quad 1 \leq j \leq m
\]

\[
\delta_j = \sum_{i=1}^{\min(j,n)} \alpha_i \delta_{j-i} \quad \text{for} \quad j > m
\]

The impact multiplier is then given by \( \delta_0 = \beta_0 \).

The interim multiplier by \( \sum_{j=0}^{J} \delta_j \) for \( j = 0,1,2,\ldots \).

The long run multiplier by \( \sum_{j=0}^{\infty} \delta_j = B(1)/A(1) \).

References


