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## THE CASH USE OF THE MALAYSIAN RINGGIT: CAN IT BE MORE EFFICIENT?\*

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The current (as of 2012) denominational range of the Malaysian ringgit has banknotes of RM1, 5, 10, 20, 50 and 100, but no RM2. The previous range (1996) carried RM1, 2, 5, 10, 50 and 100, but no RM20. We compare the efficiency of these two ranges with a full range like the Euro has, that is, 1, 2, 5, 10, 20, 50 and 100. We estimate that if the Bank Negara Malaysia would reintroduce an RM2 banknote, the efficiency of the payment system in Malaysia would increase substantially.

*Keywords:* Cash payments; efficiency; denomination range.

*JEL Classifications:* E42, E58

### 1. Introduction and Question

One of the tasks of central banks is to issue banknotes and coins. These notes and coins are ordered in a so-called denominational range, where sequences of 1, 2 and 5 can be used, although one also sometimes sees 1, 2.5 and 5, or (more rare) 1, 3 and 5. Paying with cash is still very common, even though at this time and age people also often use credit or debit cards, see [Van der Crujisen \*et al.\* \(2017\)](#). The creation and maintenance of banknotes and coins is a costly process, see for example [Segendorf and Jansson \(2012\)](#), and it is therefore important that the available notes and coins are used efficiently. Issuing coins or notes that are not used is a waste of resources. At the same time, having a denominational range that forces people to use too many notes or coins than necessary is also economically inefficient.

The Euro carries banknotes with values 5, 10, 20, 50, 100, 200 and 500, where the latter two are rarely used. The US Dollar (USD) has banknotes with values 1, 2,

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\*The idea of this paper came up with the first author when he visited Kuala Lumpur in August 2019 and noticed that a banknote RM2 does not exist, which eventually resulted in a wallet full with RM1 notes.

5, 10, 20, 50 and 100. These two ranges can be called optimal as they facilitate making many efficient payments.

An efficient payment means that a payment amount can be paid with many as-little-as-possible transactions. For example, there are two efficient payment schemes for the amount of 3 USD and these are USD1 plus USD2 and USD5 with USD2 in return. All other ways involve inefficient payment schemes. The more efficient the payment schemes per payment amount, the better it is.

For any transaction amount, one can compute the number of efficient payment schemes. The algorithm for this purpose, proposed in Cramer (1983) and which was further modified and improved in Franses and Welz (2019), is very useful and simple to implement.

The current (as of 2012) denominational range of the Malaysian ringgit has banknotes of RM1, 5, 10, 20, 50 and 100. The previous range (1996) carried RM1, 2, 5, 10, 50 and 100. So, as compared with the Euro and the USD, the ringgit first did not have the RM20, and nowadays they do have the RM20 but not the RM2. In this paper, we estimate the increase in payment efficiency if the Bank Negara Malaysia would currently re-introduce the RM2 banknote.<sup>1</sup>

## 2. Methods and Results

To compute the number of efficient payment schemes, we rely on the algorithm developed in Cramer (1983) and further extended in Franses and Welz (2019). Denote with  $P$  the payment amount and write  $N(P)$  as the amount of notes and coins necessary for cash payment. The denomination range is the set  $\{1, 2, \dots, R\}$  with  $r$  an element of this set. The current (as of 2012) range of the Malaysian ringgit includes banknotes of RM1, 5, 10, 20, 50 and 100, and coins RM0.05, 0.10, 0.20 and 0.50. Write with  $N(P, r)$  the number of tokens of denomination  $r$ , so

$$N(P) = \sum_{r=1}^R N(P, r).$$

Finally, write  $v(r)$  as the value of denomination  $r$ . The objective of Cramer's algorithm is to solve

$$\begin{aligned} \text{minimize } N^*(P) &= \sum_{r=1}^R |N(P, r)| \\ \text{subject to } \sum_{r=1}^R N(P, r)v(r) &= P. \end{aligned}$$

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<sup>1</sup>Our study is based on theory, while for example Franses and Kippers (2010) use experiments based on the Monopoly game to examine what happens when a denomination range misses certain banknotes.

Table 1. Results for the Malaysian Ringgit on efficient payment schemes, where we consider payment amounts ranging from RM1 to RM250 with steps of RM1. All banknotes means: RM1, 2, 5, 10, 20, 50 and 100.

	All banknotes	No RM20 (1996)	No RM2 (2012)
Amount of efficient schemes	456	329	413
Amount of banknotes exchanged	1755	1303	1761
Average	3.849	3.961	4.264
Median	3	4	4
Minimum	1	1	1
Maximum	6	6	7

By taking the absolute value of  $N(P, r)$ , we allow for the possibility that notes and coins are returned as change. The algorithm is further described in the appendix by [Franses and Welz \(2019\)](#).

The first set of results is presented in Table 1, where we consider the case of using banknotes only for amounts up to RM250 with steps of RM1. With the denominational range of 1996, that is, without RM20, relative to the case with all banknotes, the amount of efficient schemes reduces from 456 to 329. With the range of 2012, that is, without the RM2, the amount of efficient schemes reduces to 413, which is a reduction of  $-9.7\%$ . When we look at the average number of banknotes exchanged, not having the RM2 banknotes increases the average from 3.849 to 4.264, which is an increase of  $10.8\%$ .

Table 2 presents similar results, but now for the case with amounts up to RM1000. The average of the banknotes exchanged increases with  $5.5\%$  when there

Table 2. Results for the Malaysian Ringgit on efficient payment schemes, where we consider payment amounts ranging from RM1 to RM1000 with steps of RM1. All banknotes means: RM1, 2, 5, 10, 20, 50 and 100.

	All banknotes	No RM20 (1996)	No RM2 (2012)
Amount of efficient schemes	1790	1320	1620
Amount of banknotes exchanged	13545	10200	12930
Average	7.567	7.727	7.982
Median	7	8	8
Minimum	1	1	1
Maximum	13	14	14

Table 3. Results for the Malaysian Ringgit on efficient payment schemes, where we consider payment amounts ranging from RM1 to RM250 with steps of RM0.05. All tokens means: RM0.05, 0.10, 0.20, 0.50, RM1, 2, 5, 10, 20, 50 and 100.

	All tokens	No RM20 (1996)	No RM2 (2012)
Amount of efficient schemes	15166	11331	11245
Amount of tokens exchanged	86733	66541	65747
Average	5.719	5.873	5.847
Median	5	5	5
Minimum	1	1	1
Maximum	9	9	9

is no RM2. The number of efficient payment schemes reduces from 1790 to 1620, which is a reduction of  $-9.5\%$ .

Additional to banknotes, the denominational range of Malaysia also includes coins of RM0.05, 0.10, 0.20 and 0.50. Table 3 presents the results for all amounts up to and including RM250, with steps of RM0.05. We see that in particular, without the RM2 banknote, the number of efficient payment schemes reduces from 15,166 to 11,245, which is a reduction of  $-25.9\%$ . Similar results appear in Table 4 where all amounts are considered until and including RM1000.

Table 5 summarizes the key results. When the Bank Negara Malaysia would reintroduce a banknote of RM2, the number of efficient payment schemes would increase with around 10% if we only consider banknotes and around 35% if we

Table 4. Results for the Malaysian Ringgit on efficient payment schemes, where we consider payment amounts ranging from RM1 to RM1000 with steps of RM0.05. All tokens means: RM0.05, 0.10, 0.20, 0.50, RM1, 2, 5, 10, 20, 50 and 100.

	All tokens	No RM20 (1996)	No RM2 (2012)
Amount of efficient schemes	59542	45432	44112
Amount of tokens exchanged	561613	437408	421508
Average	9.433	9.628	9.555
Median	9	9	9
Minimum	1	1	1
Maximum	16	17	16

Table 5. Consequences of reintroducing the RM2 banknote.

	Banknotes		All tokens	
	Maximum amount		Maximum amount	
	RM250 (%)	RM1000 (%)	RM250 (%)	RM1000 (%)
Increase efficient payment schemes	10.4	10.5	34.9	35.0
Decrease average tokens exchanged	-9.7	-5.2	-2.2	-1.3

consider all tokens. At the same time, the amounts of tokens exchanged reduces with around 10–1%, depending on which tokens are considered. All in all, it seems that the efficiency of the Malaysian payment system would improve enormously if the RM2 would be reintroduced.

### 3. Conclusion

The conclusion of our study is that if the Bank Negara Malaysia would reintroduce an RM2 banknote, the efficiency of the payment system in Malaysia would increase substantially. As a public policy consideration, such an increase of efficiency would reduce the costs of making additional notes and coins that are now used to substitute the missing RM2 note.

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