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**Is Cash Dead? Using Economic Concepts  
To Motivate Learning and Economic Thinking**

*NOTE: This paper is a revision of University of Canterbury WP No. 2016/30*

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***WORKING PAPER***

**No. 10/2018**

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### **Is Cash Dead? Using Economic Concepts To Motivate Learning and Economic Thinking**

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**Abstract:** Simple but neglected concepts such as the velocity of circulation are ideal to open up discussions in macroeconomics classes, in this case about why the demand for money may rise or fall and about the likelihood of a cashless society. First, we review the history of the velocity of circulation. Next, we provide details of a research exercise in an undergraduate macroeconomics course. This exercise includes students searching for data on financial and monetary systems and national accounts. Data sources and links are provided for different countries. We also explain how such an exercise can be used to further Excel skills of students. Finally, we discuss our experiences from this exercise, including student feedback about the exercise from a survey we conducted.

**Keywords:** Teaching Macroeconomics, Velocity of Circulation, Cashless Society, Undergraduate Research.

**JEL Classifications:** A22

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## 1. Introduction

The velocity of circulation is a macroeconomic concept that is all too often neglected or mistreated in the macroeconomics curriculum. It is usually introduced as an aggregate relationship involving money holdings and the price level and then quickly consigned to the bin labelled “stays constant”. From that point on the velocity of circulation makes no further appearances and is rapidly forgotten. For example, Mankiw (2016) in his popular intermediate macroeconomics textbook, *Macroeconomics*, discusses the velocity of circulation (usually denoted as  $V$ ) as part of the quantity equation and then the money demand equation over a total of two and a half pages in his chapter on inflation. But it’s really only to get to assuming  $V$  is constant to get the quantity equation, and thus link money to the price level. After this the velocity of circulation or the income velocity of money, play no part in his textbook, even in subsequent chapters investigating monetary policy. This is not an unusual treatment of the velocity of circulation as we illustrate later.

This is a shame because the velocity of circulation can in fact be used to stimulate learning and economic thinking in a number of ways. First,  $V$  is easy to calculate so a course lecturer can set a student assignment that focuses on the key skills of sourcing, selecting and presenting data. Second, students can then provide an interpretation of what a rising or falling  $V$  means in terms of people demanding money. Third, students can analyse why  $V$  may be rising or falling. The emphasis is on proposing plausible theories that use economics to explain what is observed. In particular, a focus on the velocity of circulation of cash allows students to address the question of whether or not we are actually moving to a cashless society (as many people probably believe). Finally, students can examine how changes in  $V$  can potentially complicate monetary policy. This is particularly pertinent when discussing what was known as quantitative easing which occurred in response to the global financial crisis. For instance Martin and Milas

(2012, 763) in a survey of econometric studies studying the effects of quantitative easing on interest rates and economic activity find “...QE is a rather weak policy instrument...” Gros, Alcidi, and De Groen (2015) come to a similar conclusion. One explanation for these findings could be that people and businesses simply held on to the extra money and so quantitative easing would have little impact on economic activity. A declining  $V$ , which is easy for students at the introductory and intermediate levels to calculate, would be evidence supporting this possibility.

In this paper we focus mostly on the velocity of circulation of cash as that is most relevant to considering the “cashless society” question. However, the velocity of circulation for other monetary aggregates is easy to calculate and also useful. The velocity of circulation has not always been so neglected. This paper examines how principles and intermediate texts have treated the velocity of circulation and how it has changed over time. We suggest some potentially useful narratives that might enrich the teaching of macroeconomics and conclude with some suggestions for the classroom.

## **2. What is $V$ ?**

The velocity of circulation is most easily thought of as the speed at which money circulates around the economy.<sup>1</sup> That is, for a given nominal value of expenditure, how many times does a unit of currency change hands in the process of payments between economic agents for the transactions that make up the expenditure? If economic agents wish to hold a large amount of money relative to their expenditures then velocity will be slow and the converse is true for smaller desired holdings. This idea is captured in the definitional equation of  $V = P \cdot Y / M$ , where the “price level” ( $P$ ) in combination with real GDP ( $Y$ ) indicate nominal expenditure,

and one or other of the measures of monetary aggregates ( $M$ ) indicates how much money is used as a means of payment for the transactions making up that expenditure.<sup>2</sup>

From there this identity is usually re-arranged to the familiar “equation of exchange” or  $M \cdot V = P \cdot Y$ . As indicated in table 1, the purpose of the equation of exchange for most modern texts is to explain the relationship between  $M$  and  $P$ . Hence at this point, it is usually assumed that  $V$  is constant and that  $Y$  is determined by things other than  $M$  or  $P$ . As Blaug et al (1995) explains:

*“...the quantity theory of money really consists of three interrelated propositions: (a) the causal arrow runs from money  $M$  to prices  $P$ ...; (b) there is a stable demand for nominal money-balances-to-hold, sometimes known as the velocity of circulation of money  $V$ ...; and (c) the volume of transactions  $T$  or the volume of output  $Y$ ... is determined independently of the quantity of money or the level of prices but rather by real variables such as endowments, preferences and technology.” (29)*

**[Insert Table 1 about here]**

From these propositions and the equation of exchange, the crude quantity theory of money can be derived from rearranging the equation of exchange to put it in terms of  $M$ , or  $M = kP$  where  $k = Y / V$ . In other words, the price level will always be some constant multiple of the money supply determined by the ratio of  $Y$  to  $V$ . All of this serves to get to the end point which is to show that changes in the price level are brought about by (exogenous) changes in the money supply.

To make this relationship more explicit, sometimes the equation of exchange can be converted into a dynamic (approximation) form written in terms of percentage changes (indicated by the caret symbol),<sup>3</sup>

$$\hat{M} + \hat{V} = \hat{Y} + \hat{P}.$$

Writing the quantity theory of money in terms of percentage changes highlights that if the percentage change in velocity ( $\hat{V}$ ) is assumed to be constant (usually equal to zero) and output is assumed to grow at a constant rate then there exists a clear relationship between money growth and inflation.<sup>4</sup>

The quantity theory of money is one of the “oldest surviving theories in economics” (Blaug et al 1995, 27). Blaug et al (1995) credit John Locke with the earliest coherent statement of the quantity theory in 1692. However, the early economists did not simply assume the velocity of circulation away or see it of little analytical use. Laidler (1991, 16) notes how early monetary economists (for example Mill and Hume) were well aware that assuming a constant velocity of circulation was convenient but did not hold in the real world. Laidler (1991, 127) lays out the work of Knut Wicksell who saw the availability of credit as a major influence on changes in  $V$  and hence on changes to the price level. He also notes the work of Fisher in setting out some determinants of the velocity of circulation (72) including both speculative and precautionary types of motives. Bordonio and Jonung (1987, 19) note that Irving Fisher stresses the transaction motive for money and so expected  $V$  to continue to rise as financial innovation reduced the need for money balances to settle transactions. Blaug et al (1995) note that the three interrelated propositions that underlay the quantity theory of money (see above) “...are highly controversial and by no means truisms” (29).

Another way to think about  $V$  is that it is “...the inverse of the percentage of income that people keep in the form of money. ... Velocity is therefore essentially a measure of income-adjusted money demanded” (Caplan 2009). This turns out to be a very useful pedagogical way to think

about  $V$ , as if  $V$  is rising, then money demand is falling in real terms and vice versa. Goldfeld and Sichel (1990) give a comprehensive survey of the demand for money.

### **3. What has actually happened to $V$ ?**

As discussed, most modern texts pay less attention to the velocity of circulation than older ones and are more likely to assume (explicitly or implicitly) that  $V$  is constant to concentrate on the link between money supply and the price level. This assumption might be a good approximation to reality in the very short-run, but is otherwise not borne out by the facts.

Figure 1 shows how the income velocity of circulation for notes and coins has changed over time for four selected countries. In broad terms the overall picture is one of declining velocity of circulation from the start of the twentieth century to around the middle of the century. There then follows an increasing velocity until around the late 1980s and early 1990s. After that the velocity of circulation declines.

**[Insert Figure 1 about here]**

Bordo and Jonung (1987) discuss several possible explanations for the U-shaped velocity curve that exists until around the 1980s but in the end do not find any of the explanations wholly satisfactory. The first is income, advanced by Friedman and Schwartz in 1963. If money is assumed to be a luxury good, then the demand for holding cash balances rises as income rises. However, this explanation suggests a falling velocity and fails to explain the subsequent rise. Real interest rates are a well understood as a determinant of money demand because they reflect the opportunity cost of holding money over alternative higher return assets. But the changes in interest rates fails to explain the long run behaviour of  $V$ . Expected inflation also reduces the return on money since money is a nominal asset and higher inflation erodes its purchasing

power. Higher rates of expected inflation will increase the velocity of circulation. However, this is unlikely to explain long term, secular changes in  $V$ . A primary function of money is as a medium of exchange. Financial innovation has been a noticeable feature of financial markets and the rising availability of credit instruments and money substitutes has reduced the need for cash holdings. If the transactions motive for holding money is the biggest influence on money demand then the need to hold money will decline and  $V$  will rise as advancing technology in the finance sector makes alternative payment methods more common.

Bordo and Jonung (1987) instead argue that the fall in  $V$  is the result of increased use of payment methods such as credit cards and the ability to transact electronically the need for money balances to be held in an easily spent form. Ireland (1991) finds evidence that supports Bordo and Jonung's institutional view. These arguments foreshadow what should be a continuing rise in  $V$  as demand for cash continues to fall as society moves to an even more financially sophisticated system. Siklos and Eckhold (1997) expected this to happen. Many in society would likely agree given their day to day experience with online payments, use of credit cards and new mobile phone based technologies. This view is reinforced by headlines such as "*The countries where cash is on the verge of extinction*" (Hay 2015, November 10) and "*Sweden Is Developing the World's First Cashless Economy*" (Comiteau 2016, November 29). Many people have a growing sense that cash is costly to handle and riskier to hold as suggested in a news article headed "*The real cost of carrying cash*" (Burgess 2016, April 15). Reading that "*Woman donates \$26,000 to Salvation Army - by mistake*" (Young 2016, July 6) simply confirms what we all thought all along – cash is risky.<sup>5</sup>

Trying to explain what has caused the somewhat unexpected decline in  $V$  is a very interesting question for students to propose theories for. There are no clear and obvious explanations as to

why people are holding more cash and not less. The Federal Reserve Bank of St. Louis (2014) notes how, rather than being constant in recent years,  $V$  has slowed dramatically following a period of decline since the mid-1980s. They credit the cause of the recent decline to the “...private sector’s dramatic increase in their willingness to hoard money instead of spend it.” Why this increase? They suggest two reasons: (i) a “gloomy economy”; and (ii) a sharp reduction in interest rates which prompts a move towards holding more cash in investment portfolios. The exact meaning of a “gloomy economy” is difficult to determine. One possible interpretation is that a poor economy means fewer transactions so velocity falls but this is a dramatic fall. We suggest the increased perceived risk premium of the financial sector following the global financial crisis has led to an increased desire to hold cash as a relatively risk-free asset. This is exacerbated by the fall in interest rates but would likely have occurred regardless as faith in the financial sector was eroded. After all, interest rates have been low before. Again none of this explains the *long term* decline.

For whatever reason, money holders are holding more cash relative to the value of their transactions and more cash in real terms. It would seem that the shift to a cashless society is yet to occur in New Zealand, Australia, the UK and US at least. Some countries do seem to be shifting in that direction. Sweden (which is mentioned in the news articles above) does seem to be one of these with consistent falls in the average value of banknotes and coins in circulation from SEK 99 billion in 2011 to SEK 57 billion in 2017, a 42 percent decrease.<sup>6</sup> However, the interesting question to assign students is to explain those who are not.

#### **4. Bringing velocity into the classroom**

As is evident from the data, a constant  $V$ , while useful and acceptable in the short run, isn’t a tenable assumption over all time periods. But rather than being a problem, it creates learning

possibilities, particularly in relation to learning more about: how to find, present, and analyse economic and data; the structure and operation of the monetary and financial system; monetary policy; macroeconomic history; and how knowledge is advanced in economics.

The first type of exercise an instructor could ask students to do is to create a graph of the velocity of circulation ( $V$ ) for notes and coins over several decades to the most recently available time period. Apart from simply studying how  $V$  has changed over time, it provides an opportunity for students to learn about what macroeconomic data is available, what organisations create and store data, and how different macroeconomic and financial variables we mention in class are actually measured. Since data for earlier periods can be difficult to find it may be necessary to provide historical data to students and require that they find the more recent data that is more readily available. Individual course instructors will need to make this decision for themselves.

Once students have obtained or been given a time series of  $V$ , instructors can use any significant periods of change in  $V$  to stimulate discussions about how people pay for transactions (Schreft 2006), the demand for money (Goldfield and Sichel 1990), and financial innovation (Quinn and Roberds 2008). For example,  $V$  slows down for the first part of the twentieth century. A natural question to ask students is what does a fall in  $V$  mean in terms of the demand for money? This leads into payment methods, money held for precautionary motives, and why liquid assets such as money can be desirable in a portfolio. One possible explanation for the fall in  $V$  is that households shifted towards money and away from other payment methods (e.g. barter) and from consuming their own household production. The economy is specialising, trading and “monetising”. Bordo and Jonung (1987) do not find any of these explanations wholly satisfactory. Instead they explain the fall in  $V$  by

*“... the monetization process. This process consists of two interrelated developments: (1) the growing use of “money” for settling transactions at the expense of a decline in barter and payments in kind, occurring simultaneously with an expansion of markets and a decline of production for own consumption; and (2) the rise of a commercial banking system supplying the public with notes and deposit facilities.” (22)*

The subsequent rise could then be argued to reflect an increasingly more sophisticated financial system which provided alternative ways to pay than using cash. Quinn and Roberds (2008) provide a detailed and very accessible history of the evolution of the check as a payments technology from the thirteenth century onwards and how it reduced the demand for currency. Stix (2004) documents an example of debit cards causing a reduction in the demand for currency. Demand for cash therefore declines so  $V$  rises. The fall in  $V$  from the 1980s is more surprising and difficult to explain but also very interesting. By the mid-1980s there was an expectation that financial innovation would continue to drive  $V$  ever upwards – especially for notes and coins – as financial innovation reduced the demand for cash (Cane 1982, January 18) and Mittelstaedt (1984, October 1).<sup>7</sup> But for whatever reason, demand for cash has been rising. Discussion could encompass factors such as a lack of confidence in the financial system due to financial crises (Stix 2013), or an expanding black market and grey economy (Schneider and Enste 2000; Organisation for Economic Co-operation and Development 2017; Europol 2015) where transactions are conducted in cash, or continued low interest rates that have existed since the early 1990s make the cost of holding cash small (Briglevics and Schuh 2013), and so on.

Studying the velocity of money naturally lends itself to answering a longstanding and still most topical question, are we moving towards a cashless society? This issue has been around since at least the 1950s and 60s (Reistad 1967; Lee 1967) with regular claims that a cashless society is imminent (Wright 1982, April; Ramo et al 1998, April; Acton and O’Grady 2008, October

15). A falling  $V$  means that from the start of the twentieth century to the middle of it, demand for cash holdings was rising. For around the next 40 years cash demand falls as shown by  $V$  rising. After that demand for cash increases again. Cash, it would appear, is not dead despite widely held views that a “cashless society” is upon us (Keeley 1988; Bagnall et al 2016). Popular media articles will pick up on this, often with some surprise in their tone.<sup>8</sup> While more and more transactions are conducted in non-cash ways, cash holdings are still very attractive as highlighted by Bech et al (2018) and Drehman, Goodhart, and Kreuger (2002). Why this is so can make a good discussion point in class, or be the basis of an essay which students would very likely find interesting if our experience is to go by.

A closer examination of the velocity of circulation provides a platform for further discussion on how variation in  $V$  could make monetary policy more complicated than an assumption of constant  $V$  would suggest. For example, attempts by central banks to stimulate economies following the Global Financial Crisis (GFC) may have been partially neutralised by a slowing velocity of circulation. Martin and Milas (2012) and Gros, Alcidi, and De Groen (2015) provide evidence for the United States, United Kingdom and Europe. Berkmen (2012) finds this for Japan and Cusbert and Rohling (2013) document how the demand for currency rose substantially in Australia after the global financial crisis. In a world where the velocity of circulation is not constant, monetary policy becomes substantially more difficult. This is not necessarily a new realisation. In 1983, Gerald Bouey as Governor of the Bank of Canada, stated that “We did not abandon  $M1$ ,  $M1$  abandoned us.” (Crow 2013, 12). The belief that central banks could simply target  $M1$  growth in order to control inflation had proven to be incorrect and the world is indeed a far messier place (Thiessen 2000, October).<sup>9</sup> This contrasts with the way in which monetary policy is sometimes taught – that a central bank simply pulls the lever

and gets the expected outcome that it wants. This may be more relevant to instructors of intermediate macroeconomics.

Changes in the velocity of money can easily be linked to important historical economic events, helping students to understand the historical context of macroeconomics and how macroeconomic thinking has changed. One significant event which can be studied is the high inflation rates of the 1970s and 1980s and their effect on the demand for money (Blejer 1979; Smirlock 1982; Goldfield and Sichel 1990). Higher inflation rates result in greater costs of holding cash so we could expect  $V$  to rise. But higher average inflation is also usually accompanied by more variable and uncertain inflation which could even lead to a higher precautionary demand for money which would cause  $V$  to fall. The possible impact of inflation on the demand for money and its velocity can thus lead into understanding more about inflation itself, including how variations in the rate of inflation are linked to the average rate of inflation, and how this uncertainty can be another cost from higher levels of inflation. The fall in  $V$  from the 1980s could be linked to falling confidence in the finance system which could be due to recurring financial markets events such as the 1980s savings and loans crisis, the 1987 stock market crash, the 2008 GFC, and European Sovereign Debt crises. Contessi and El-Ghazaly (2011) in a very accessible article describe what constitutes a banking crisis, gives details of past financial crises from different countries, and compares them to the GFC. For a historical study of the effect of financial crises on velocity and money in the United States see Anderson, Bordo, and Duca (2017). For a more global perspective see European Central Bank (2012).

## **5. Getting the students to do some work – our experience from a cashless society assignment**

We created a student research assignment about the topic of a cashless society for a standard intermediate macroeconomics university course taught in 2017 in the Department of Economics and Finance at the University of Canterbury in New Zealand. Henderson (2016) argues that such undergraduate research exercises are important in students learning and development of higher-order skills. The statement students had to address was “Countries will eventually become cashless societies.” The motivation for the topic arose from a lecture about the demand for currency, how this was related to the income velocity of money, and that a fall in the demand for currency should see a rise in the income velocity of currency. The aim of the essay was to build several useful skills in the process of learning more about the velocity of money and how it could be used to gain an understanding of the monetary system (Méndez-Carbajo 2015).

### ***Description of the Class***

The course is a semester long and enrolment was 142 in 2017. The textbook is *Macroeconomics* by Mankiw, a standard North American text. The pre-requisites for the course and introductory microeconomics and macroeconomics. The composition of students by sex was 106 (74.6 percent) male and 36 (35.4 percent) female. Most students (92.9 percent) were between 19 and 22 years old. The first degree of students was the Bachelor of Arts (16 or 11.3 percent), Bachelor of Commerce (97 or 68.3 percent), or Bachelor of Science (20 or 14.1 percent). The other nine students were scattered over other types of qualifications. Some students (14 or 9.9 percent) were double-degree students with almost all of these being one of the above degrees with the Bachelor of Laws. Relatively more males were science students than the composition of the class, but the difference was not large. Overall, the distribution of students by sex across

the different qualifications mirrored that of the class as a whole. Over 71 percent (102) of the class was of European ethnicity, 16.2 percent (23) were East-Asian, 7 percent (10) were indigenous Maori, with other ethnicities making up the remainder of the class. Just over 83 percent of the students were New Zealand citizens.

Before starting the course, 2.1 percent of the students had a failing Grade Point Average (GPA), 38 percent had a GPA in the C range, and 45.8 percent had a GPA in the B range and 14.1 percent had an A range GPA.<sup>10</sup> By the end of the semester 12 percent of the class had failed the course and the average GPA of students in the class of 3.9 (C+) compared to 4.6 (B-) of students entering the class.

### ***Assessment Exercise and Purpose***

The assessment item given to the students as shown in figure 2 had three primary objectives. The first was for students to learn more about the concepts and theories to do with the velocity of money, the quantity theory, the demand for money, and innovation in payments technologies. At the same time students would learn how to propose plausible theories that are grounded in economics. The second objective was to improve students' knowledge about the sources and characteristics of economic data, and the organisations that collect and use it. The final major objective was to enhance students' data analysis and spreadsheet skills, including how to design spreadsheets. Barreto (2015) explains how Excel offers an excellent option for improving learning outcomes in the classroom. The column by Bishop (2016, May 11) who reports that spreadsheet errors cost United Kingdom businesses billions of pounds from their making poor decisions also highlights why developing student's spreadsheet skills is potentially attractive to prospective employers of students.

**[Insert Figure 2 about here]**

### ***Performance of the Class***

The reaction of students to the essay topic was enthusiastic. The subject is highly topical and widely discussed in the media, and it is one they could easily relate to since it was about how they personally paid for transactions. The higher interest from students resulted in higher effort and only a couple of students actually failed the essay compared to just under ten percent for the class as a whole.

A voluntary survey about students' experiences of the assessment exercise was held after the assessment had been graded and returned as suggested by Staveley-O'Carroll (2018). Since it was voluntary then of course it was subject to self-selection issues. That said, the survey respondents had very similar average and distributional characteristics to the class as a whole. The exceptions being that those who responded to the survey had a mildly better entry GPAs (5.1 average versus 4.6) and did better in the course (3.9 average versus 4.9). Over three-quarters of those surveyed said it improved their ability to use Excel and also their data handling skills. This was despite most students in the course having passed the first year Excel heavy university statistics course, STAT101 – 113 (79.6 percent) passed it, 5 (3.5 percent) failed it, and 24 (16.9 percent) had not taken it by the time the students were enrolled in ECON206.<sup>11</sup> Over 90 percent of the students surveyed said it improved their skills in finding economic information and also their knowledge of and understanding about money and the money market, including the velocity of money. The experiences of the students were independent of their having taken STAT101, how well they did in that course, and even their overall GPA.<sup>12</sup> Overall, our experience from using a simple concept such as the income velocity to create a learning opportunity has been highly positive. Furthermore, it is an opportunity which students respond well to and do seem to have learnt much from doing.

## 6. Conclusion

The assumption that the velocity of circulation is constant is a useful one in Principles of Macroeconomics courses. It allows instructors to draw the link between money and prices which is a key concept underlying monetary policy. However,  $V$  is not constant, particularly over the longer term, and there are some interesting questions that can be examined by having a look at what actually has happened to  $V$ . The decline in  $V$  for the first half of the twentieth century and the subsequent rise until around the 1980s are easy to explain and are built on interesting stories about money and methods of payment. The decline from the 1980s is more puzzling and a good opportunity for students to put forward plausible theories for what is happening.

Asking how many students believe that we are moving to a cashless society is likely to reveal that a majority do believe this to be true. But is cash dead? The evidence provided by graphs of real notes and coins per person and the velocity of circulation of notes and coins suggests otherwise. Such graphs are easy to create and relatively straightforward for students to grasp. The topic lends itself to an assignment that builds useful skills or to more active and interactive forms of teaching as it is simple to do in real time.

In the short term, assuming  $V$  is constant is tolerably close to reality. However, incorporating a non-zero value in the dynamic (percentage change) form of the quantity theory of money is not difficult. By moving away from the simple assumption of “ $V$  is constant”, students are forced to confront the question that the central bank must face – what assumption *should* be made about  $V$ ? This alerts students to the more complicated nature of monetary policy in a changing and uncertain world. This latter point is probably more relevant to instructors of intermediate macroeconomics but could easily be covered in principles courses.

Economics is at its best when it addresses questions that students had never thought to ask because surely the answer is obvious but when it turns out the answer is not.

## Notes

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<sup>1</sup> For the really interested there are usually two concepts of the velocity of circulation. One is called the transactions velocity where the number of transactions ( $T$ ) is the quantity variable, i.e.  $V = PT/M$ . The income velocity usually takes the quantity variable as real GDP hence the right hand side has nominal GDP, i.e.  $V = PY/M$ . In practice the number of transactions ( $T$ ) is not observable so it is the income velocity that is being referred to. These measures can be quite different. For example, an economy with a large number of transactions for second hand goods will have a different transactions velocity than another economy with a smaller number of such transactions. However, both may have the same income velocity of circulation. This paper will use the term “velocity of circulation” and is referring to the income velocity measure.

<sup>2</sup> The exact definition of price level is usually left vague. The common implication is that the consumers’ price index (CPI) the relevant measure. However, if the income (or GDP) measure of the equation of exchange is used then  $P$  is more accurately the GDP deflator. For practical purposes at principles level, this distinction makes little difference. While any of the usual monetary definitions can be used, the focus of this paper will primarily be on notes and coins due to the interest in the idea of a cashless society.

<sup>3</sup> A more mathematically accurate method is to take logs and then totally differentiate. However, this method is beyond most principles courses so the percentage change approximation can be used instead.

<sup>4</sup> This is equivalent to taking the Classical Dichotomy (the distinction between real and nominal variables and that money affects nominal but not real variables) as a reasonable starting position to take.

<sup>5</sup> The woman in question donated her cushions to the second hand store forgetting she had stored cash in them.

<sup>6</sup> Data retrieved from Sweden’s Riksbank: <https://www.riksbank.se/en-gb/notes-and-coins/statistics/>.

<sup>7</sup> Although there were dissenters such as Keely (1988) who pointed out benefits of cash to some such as its anonymity and its attractiveness to those engaging in illegal transactions.

<sup>8</sup> See for example Yeates (2016, February 27) for Australia and Stock (2013, September 9) for New Zealand.

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<sup>9</sup> Gordon Thiessen was Governor of the Bank of Canada at the time. Sections 2.4 to 2.6 are particularly relevant and include the quote from Bouey. Canada was the 2<sup>nd</sup> country, after New Zealand to adopt inflation targeting. Has it always been the case that economics educators would consign  $V$  to the “held constant” bin early in the lesson? As table 1 shows, the answer is no. The most striking example is that of the 1951 edition of Samuelson where the velocity of circulation is given quite some space. However, more recent textbooks spend much less time discussing  $V$  – in some cases almost no time. A graph of the velocity of circulation is easy to create. If not used in a take home assignment, a graph of  $V$  could be created in class time and be used for participation type credit. All it requires are monetary aggregates (available from most central bank websites) and nominal GDP.

<sup>10</sup> The University of Canterbury has a grade scale from -1 for the lowest (and failing grade) of E to 9 for the highest grade of A+. The full scale range and associated grades are: A+ (9), A (8), A- (7), B+ (6), B (5), B- (4), C+ (3), C (2), C- (1), D-Fail (0), E-Fail (-1).

<sup>11</sup> The course description for STAT101 is: “An introduction to the ideas, techniques and applications of statistics and probability. The emphasis is on applying statistics to problems, selecting sensible techniques, following the methodology and interpreting the results. Understanding the concepts and computer-based solutions are emphasised and applications to commerce, the social sciences, the humanities, science and engineering are considered. Particular topics include data analysis, summary statistics, probability, statistical distributions, estimation and inference (including confidence intervals, hypothesis tests and modelling).” The main software used in the course is Excel.

<sup>12</sup> We created contingency tables and calculated chi-square tests of association and could not reject any null hypotheses of independence. We don’t report these as a noticeable number of the cells in each case have fewer than five counts which is usually taken as necessary for the chi-square test to be valid.

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## Appendix 1. Monetary aggregates definitions

The International Monetary Fund in its 2016 *Monetary and Financial Statistics Manual and Compilation Guide* categorises monetary aggregates by how liquid different types of financial instruments are in fulfilling their medium of exchange function as shown in table 2 (page numbers are after each aggregate). The *medium of exchange* function is defined (179) as “...a means for acquiring nonfinancial assets (goods, merchandises, equipment, etc.), services, and financial assets without resorting to barter.”

**[Insert Table 2 about here]**

The measures of monetary aggregates for each country satisfy these definitions although the specific financial instruments included the measures can differ from country to country. This means that instructors might require students to specify the sources and definitions of their data. Definitions of monetary aggregates are available from the following sources:

*Australia* – <http://www.rba.gov.au/glossary/index.html?search=monetary+aggregates>

*Canada* – <https://www.bankofcanada.ca/rates/indicators/key-variables/monetary-aggregates/>

*European Monetary Union* – [http://www.ecb.europa.eu/stats/money\\_credit\\_banking/monetary\\_aggregates/html/index.en.html](http://www.ecb.europa.eu/stats/money_credit_banking/monetary_aggregates/html/index.en.html)

*Japan* – <https://www.boj.or.jp/en/statistics/outline/note/notest31.htm/>

*New Zealand* – <https://www.rbnz.govt.nz/statistics/c50-money-and-credit-aggregates>

*United Kingdom* – <https://www.bankofengland.co.uk/quarterly-bulletin/2014/q1/money-in-the-modern-economy-an-introduction> [click on the pdf file]

*United States* – <https://www.federalreserve.gov/releases/h6/current/default.htm>

## Appendix 2. Possible data sources

### International Data:

- an index for *M1* and *M3* is available for a range of countries from <http://stats.oecd.org/>.
- <http://www.imf.org/en/data> – International Monetary Fund
- <https://data.oecd.org/finance.htm> – Organisation for Economic Cooperation and Development
- <https://www.bis.org/statistics/index.htm> – Bank of International Settlements
- [https://www.ecb.europa.eu/stats/money\\_credit\\_banking/html/index.en.html](https://www.ecb.europa.eu/stats/money_credit_banking/html/index.en.html) – European Central Bank

### Australian Data:

- <http://www.rba.gov.au/statistics/tables/> (table D3)
- <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Jun%202016?OpenDocument>

### Canadian Data

- <https://www.bankofcanada.ca/rates/banking-and-financial-statistics/>
- <https://www.statcan.gc.ca/eng/nea/index>

### Japanese Data

- <https://www.boj.or.jp/en/statistics/money/index.htm/>
- <http://www.stat.go.jp/english/data/nenkan/1431-03.htm>
- <http://www.stat.go.jp/english/data/cpi/index.htm>

#### New Zealand Data:

- <http://www.rbnz.govt.nz/statistics/c1>
- <http://www.stats.govt.nz/>
- <https://www.paymark.co.nz>

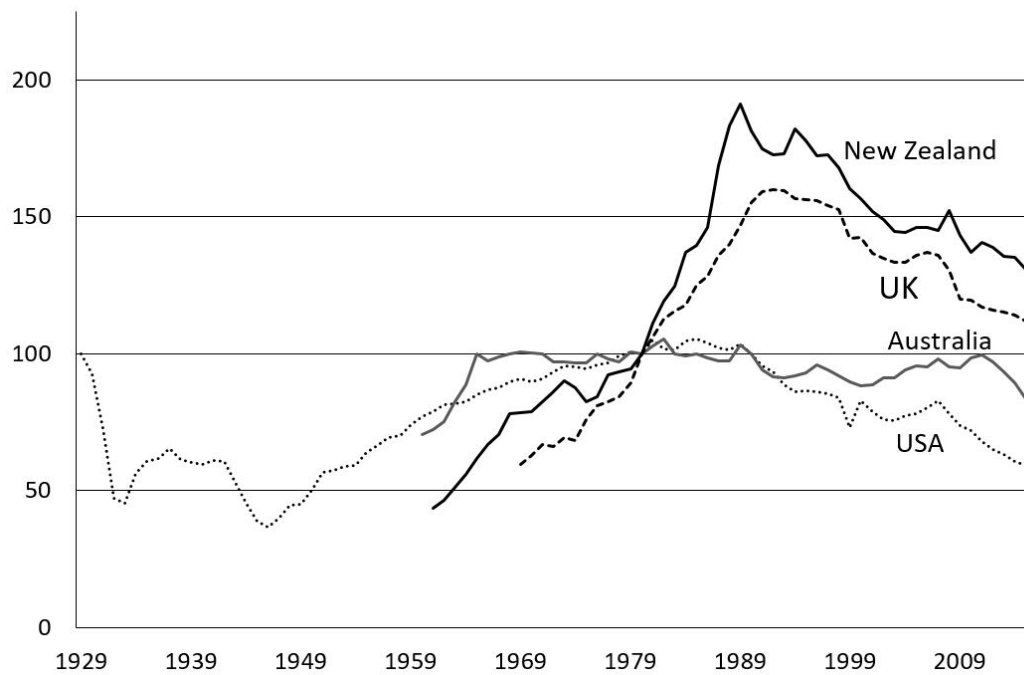
#### United Kingdom Data:

- <http://www.bankofengland.co.uk/boeapps/iadb/index.asp?first=yes&SectionRequired=A&HideNums=-1&ExtraInfo=false&Travel=NIxSTx>
- <http://www.ons.gov.uk/economy/grossdomesticproductgdp>

#### United States Data

- [https://www.federalreserve.gov/paymentsystems/coin\\_currircvalue.htm](https://www.federalreserve.gov/paymentsystems/coin_currircvalue.htm)
- <https://fred.stlouisfed.org/series/GDPA>
- Earlier data for monetary aggregates can be found here  
<https://research.stlouisfed.org/wp/2003/2003-006.pdf> (p.48)

**Figure 1.** Notes and coins velocity of circulation for New Zealand, Australia, the United Kingdom and the United States (Index 1980=100).



*Note:* Data is from Bordo and Jonung (1987).

**Figure 2.** Example of a student assignment on cashless societies

**Report Instructions**

1. For your report assume you are working for an economic consultancy and are writing a commissioned report for the central bank, the retail banks, and credit card companies, considering the following issue: “Countries will eventually become cashless societies.”
2. Include exactly two graphs (no more and no fewer) you have created from data that are relevant to and support your arguments and conclusions. The graphs must be properly labelled, well formatted, and include data sources and definitions in table notes.
3. You must use an Excel data file to store your downloaded data, calculate any of your data, calculate statistical relationships using your data, and for creating the graphs of your data. A third of the report mark will be based on the quality of your Excel data file. The quality of the data file depends on how easy it is for someone who has done no work on the topic to open your Excel file, know the exactly what the data you have included measures, be able to replicate downloading it from the sources of your data, be able to understand any calculations you perform or statistical measures you calculate or estimate, and be able to understand and replicate your two graphs. Your Excel file has to be neatly and logically organised.

**Table 1.** Examples of the treatment of the income velocity of money in principles texts over time and countries.

| Text and No. of Pages on the QTM / EOE             | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Samuelson (1951)<br>9 pages (346-356)              | Although the QTM appears in an appendix it is dealt with in some depth. The text starts with the simple form $M = kP$ . After discussing the inadequacy of this, $V$ is then introduced. The author asserts that “... <i>the velocity of circulation is not even approximately constant.</i> ” (350). The author puts the failure of quantity theorists (who took $V$ as constant) down to focusing on the transactions demand for money and ignoring other reasons why people hold money (e.g. stability of the financial system): “ <i>the velocity varies with changes in interest rates, expectations, saving and investment schedules, and other economic variables.</i> ” (335). |
| Samuelson et al (1975)<br>8 pages (345-352)        | This edition is somewhat softer on the notion that $V$ is nowhere near constant but there is still a clear assertion that an assumption of constancy is not reasonable: “ <i>while <math>V</math> is definitely not a constant, its movements are subject to some regularity and predictability</i> ” (352). The velocity of circulation gets a further mention in the appendix to a later chapter (422-428).                                                                                                                                                                                                                                                                          |
| Begg, Fischer and Dornbusch (1984)<br>1 page (616) | The QTM discussion is a side box. The text argues that $V$ will be constant except as interest rates and inflation vary: “ <i>...if inflation and nominal interest rates settle down at some particular level, velocity will become constant</i> ” (616).                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Abel and Bernanke (2005)<br>4 pages (260-263)      | The text starts with the definition of $V$ and re-arranges to $MV = PY$ and notes that $V$ for $M1$ is “ <i>...clearly not constant</i> ” (261) giving potential reasons for this (e.g. interest rates and financial innovation). Velocity of $M2$ is “ <i>...closer to being constant</i> ” (261). There is no discussion of how and why $V$ might or could change. A graph of $M1$ and $M2$ velocity is shown.                                                                                                                                                                                                                                                                       |

|                                                                |                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stiglitz and Walsh<br>(2006)<br>2 pages (608-09)               | The velocity of circulation is defined and explained and then assumed as essentially constant, “ <i>For a given level of velocity...</i> ” (609).                                                                                                                                                       |
| Mankiw (2015)<br>3 pages (352-354)                             | The text starts with the definition of $V$ and re-arranges to $MV = PY$ . $V$ is considered stable, “ <i>The velocity of money is relatively stable over time.</i> ” (353). There is no discussion of how and why $V$ might or could change.                                                            |
| McTaggart,<br>Findlay and Parkin<br>(2013)<br>2 pages (508-09) | The text starts with the definition of $V$ and re-arranges to $MV = PY$ . The text implicitly assumes the stability of $V$ . There is no discussion of how and why $V$ might or could change and it states, “ <i>...in the long-run, the rate of velocity change is approximately zero.</i> ” (508-509) |

Note: QTM is quantity theory of money and EOE is equation of exchange.

**Table 2.** International Monetary Fund Definitions of Main Monetary Aggregates

| <b>Monetary Aggregate</b> | <b>IMF Definition</b>                                                                                                                                                                                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Currency (58)             | Notes and coins that are of fixed nominal values and are issued or authorized by central banks or governments.                                                                                                                                                  |
| Monetary Base (197)       | Currency in circulation, ODCs' [other depository corporations] deposit holdings at the central bank, and those deposits of money-holding sectors at the central bank that are also included in broad money.                                                     |
| M1 (322)                  | Currency in circulation plus transferable deposits held by all money-holding sectors.                                                                                                                                                                           |
| Broad Money (180)         | The sum of all liquid financial instruments held by money-holding sectors that are widely accepted in an economy as a medium of exchange, plus those that can be converted into a medium of exchange at short notice at, or close to, their full nominal value. |