“Issues concerning Hayekian triangles and Phillips curves, with real wage and real interest variables”

AUTHORS	Paul F. Gentle Mark Thornton

ARTICLE INFO	Paul F. Gentle and Mark Thornton (2014). Issues concerning Hayekian triangles and Phillips curves, with real wage and real interest variables. *Banks and Bank Systems*, *9*(2)
RELEASED ON	Monday, 23 June 2014
JOURNAL	"Banks and Bank Systems"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES **0**

NUMBER OF FIGURES **0**

NUMBER OF TABLES **0**

Paul F. Gentle (China), Mark Thornton (USA)

Issues concerning Hayekian triangles and Phillips curves, with real wage and real interest variables

Abstract

Bellante and Garrison (1988) view both conventional Phillips curve analysis (focused on real wages) and the use of Hayekian triangles (focused on real interest) to be useful in explaining business cycles. Five econometric papers have been published, with New Keynesian, New Classical Phillips Curves and similar models of conventional Philips Curve Models, with one major difference, the real interest rate variable has been added. These ideas are presented with suggestions for further study.

Keywords: Phillips curve, Hayekian triangles, aggregate supply curve, economic history.
JEL Classification: B53, E12, E24, E40, N24, N12.

Introduction

Bellante and Garrison (1988) compare the use of Hayekian triangles, which focuses on the interest rate and conventional Phillips curves, which focuses on wage rates. Despite their different focuses, they point out that both start with the kernel of truth of the Quantity Theory of Money. That is both deal with disequilibrium processes, employ short-run and long-run effects, employ endogenous self-reversing market processes, and involve monetary disturbances that produce short-run effects that are non-neutral and long-run effects that are neutral. They conclude that the use of conventional Phillips Curves and Hayekian triangles should be seen as complementary forms of macroeconomic analysis. Gentle (1984) supports the idea that New Classical, New Keynesian and similar models should consider incorporating a real interest rate variable, which is different from the conventional Phillips curve Analysis, that Bellanate et al. (1988) discuss. Recent econometric studies (Gentle et al., 2005, 2007, 2013; Chen and Gentle, 2010, 2011) use a standard real wage rate variable for Phillips curve analysis and real interest rate variable. These studies incorporate New Classical, New Keynesian and similar models and all produce significant results. There is an important difference in how capital is dealt with by Hayekian Triangles, compared to how it is *not* dealt with all by conventional Phillips curve models. In Gentle et al. (2005, 2007, 2013) and Chen and Gentle (2010, 2011), the real interest rate is expected to impact capital, with the use of lagged variables in those studies indicating capital being transformed into different uses.

In the next section of this paper, there is a description of the Hayekian triangle model and its similarities and differences with the Phillips curve. The second section of this paper, summarizes conventional Phillips curve theory and our desire to have real interest rates and real wages considered. The third section of this paper provides two historical examples, using Phillips curve and Hayekian triangles analysis – the Great Depression and the recent Housing Bubble, including its aftermath. The last section provides concluding remarks.

1. Hayekian triangles

Bellante and Garrison (1988) argue that the conventional Phillips curve and the Hayekian triangle provide complementary ways of explaining and charting business cycles. The conventional Phillips curve examines the economy, responding to monetary injections in terms of labor markets. The Hayekian triangle examines the economy responding to monetary injections in terms of capital markets. Austrian economists remind us that capital is heterogeneous and *some* capital can also be destroyed in the process and that lessens the productivity of the workers (Bellante and Garrison, 1988; Ravier, 2013).

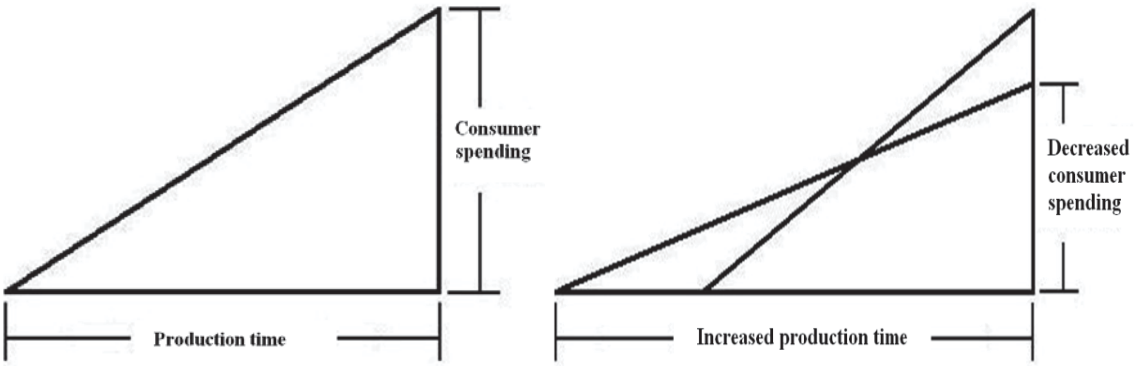
The Hayekian triangle represented in Figure 1 depicts an economy with a structure of production (hypotenuse), and the corresponding level of consumption (vertical line height). This model is designed to show in part the impact of changes in the real interest rate on the structure of production, that is, how capital goods are arranged in order to produce consumer goods. A longer structure of production (base of the triangle) indicates what Bohm-Bawerk called "a more roundabout means of production" or more simply production time. An example of a longer, more roundabout structure of production would be a dairy farm where cows are milked by robots and where the milk is transported long distances for processing. In this example, production of goods such as milk and cheese, are packaged and transported long distances to grocery store shelves. A shorter, less roundabout structure of production would be an individual who walks to the barn and milks a cow for a quart of milk and consumes it. A longer, more roundabout structure of production is more efficient and productive and once it is put in place, produces more goods (Garrison, 1989). The Hayekian triangle describes the process of growth as

follows: consumers save more and consume less. This increases the supply of savings and results in, *ceteris paribus*, an initial decrease of consumption and a fall in the rate of interest. This lower interest rate encourages entrepreneurs to borrow more and invest more, particularly in long-term investments, which increase efficiency and productivity. Capital goods resources are moved away from consumption and used in capital and time intensive production processes. As capital goods are integrated into the overall structure of production of the economy there is eventually an increase in the quantity of consumer goods. In the case of the dairy industry this would involve the design, building and installation of the milking robots, the trucks, and the central processing plant. Once the project is completed, more goods can be produced relative to the amount of resources used up.

The Austrian or Hayekian analysis of business cycles has key features. Instead of a savings induced decrease in the interest rate, the source of loanable funds is the central bank who issues unbacked fiat money. Ludwig Von Mises (1912) first described the "Austrian" theory of the business cycle in the German language edition of *The Theory of Money and Credit*. Moreover his student, Friedrich von Hayek, developed this theory and presented it to the greater world of economists. Hayek (1935) first used the triangle diagram to explain business cycles (Garrison, 1994). Mises and Hayek show that an artificial reduction of the interest rate, below the market rate would stimulate the production of long-term capital projects and initiate a lengthening of the structure of production. The difference between this scenario and the previous one is that there is no new savings; no resources have been set aside for this expansion. Not only are consumers not saving more, they are actually saving less and consuming more. This is induced by lower interest rates and the wealth effect, which discourage savings. It is the increase in investment coupled with the increase in consumption which characterizes a "boom". Hayek (1979) stated that, "Nothing is easier than creating additional employment for a time by drawing workers into activities made temporarily attractive by the expenditure of additional money created for that purpose". As these long-term capital projects are developed, entrepreneurs find that the amount of resources available is less than anticipated and soon prices and interest rates start to rise making the projects more costly and less profitable. As these entrepreneurs bid up the prices of things like raw materials and gasoline, they create price inflation and reduce the real incomes of their consumers, thus reducing their sales revenues. As these projects come on line and start producing, markets become saturated with inventory and prices begin to fall making the projects less profitable than anticipated. Therefore instead of initiating economic growth, the central bank has ignited a self-reversing process that culminates in a cluster of entrepreneurial errors, better known as a recession or bust. This second process of the business cycle is one that is started at the central bank (Garrison, 1994).

Hayek assumed that the new money is injected through credit markets – that the central bank, in effect, pads the supply of loanable funds with newly created money. The result is a drop in the interest rate, since there is an increase in loanable funds. When the interest rate increases later on, this is not due wholly to an increase in inflation. Although inflation increases the interest rate, the interest is also increased beyond that because of another factor. This other factor has to do with firms bidding up prices in the latter stages of production. It is an additional increase in the interest rate beyond the inflation premium (Bellante and Garrison, 1988).

The Hayekian triangle depicts the economy as a right triangle. The level of economic development is depicted as the length of the horizontal link and the level of consumption is the length of the vertical line. Bellante and Garrison (1988) show that the Hayekian triangle and the Phillips curve should be understood as complements. The Hayekian triangle models the capital structure. The conventional Phillips curve models the labor market.



Source: Garrison (1994).

Fig. 1. Hayekian triangles

What justifies a real interest rate variable in empirical analysis and further research, is because the interest rate impacts capital use and a temporary decrease in real interest can affect labor employed, through capital used in a complementary way with labor.

2. Phillips curves

2.1. Theoretical background. Explanations about why short-run Phillips curves could exist have focused on misperceptions of both the real wage rate and the demand for goods and services (Santoremo and Seater, 1978; Sargent, 1979; Snowdon and Vane, 2005; Carlin et al., 2006; Gordon, 2009b). Herein we show that any empirical test of the unemployment-inflation trade-off should include the real interest rate. Building on earlier works (Gentle, 1984; Gentle et al., 1995, 2005, 2007, 2013; Chen et al., 2010, 2011), we bring this idea to add to the seminal paper by Bellante and Garrison (1988). The New Keynesians, Monetarists and New Classicals (Rational Expectationists), agree that unanticipated government policy would have the most significant impact on the economy. However, New Keynesians also proclaim that anticipated policy may affect the economy (Miskin, 2010). New-Keynesians such as Mankiw (2006) and Gordon (2009a) describe the Phillips curve and the short-run aggregate supply curve (SRAS). Gordon (2009a) explains that positive supply shocks cause the SRPC to shift downward and negative supply shocks cause the SRPC to shift upward. Also, business and consumer confidence uncertainties may lead the economy to sometimes operate on the SRPC (Gordon, 1990; Mankiw, 2006; Gordon, 2009a, 2009b). The Marshallian Monetarist School advocates the partitioning of time into short-run and long-run periods; whereas, the Walrasian New Classicals do not (Santermo and Seater, 1978). Classicals differ from New Classicals, who allow for short-run deviations from full employment, if economic agents have incorrect expectations (Dornbusch et al., 1998). New Keynesians, Monetarists, and the New Classicals, have views concerning imperfect information and Phillips curves. The natural rate of unemployment (assumed in the LRPC) is "simply the market rate, given frictions, mismatches, and institutional constraints, and serves as the base point from which to analyze cyclical unemployment" (Bellante and Garrison, 1988). Monetarists and New Classicals argue that an expansionary monetary policy can produce only a temporary decrease in the unemployment rate due to the misperception on the part of labor concerning their real wage rate. If inflation is correctly anticipated, the government can no longer use inflation to mask real economic variables (Friedman, 1968, 1976, 1977).

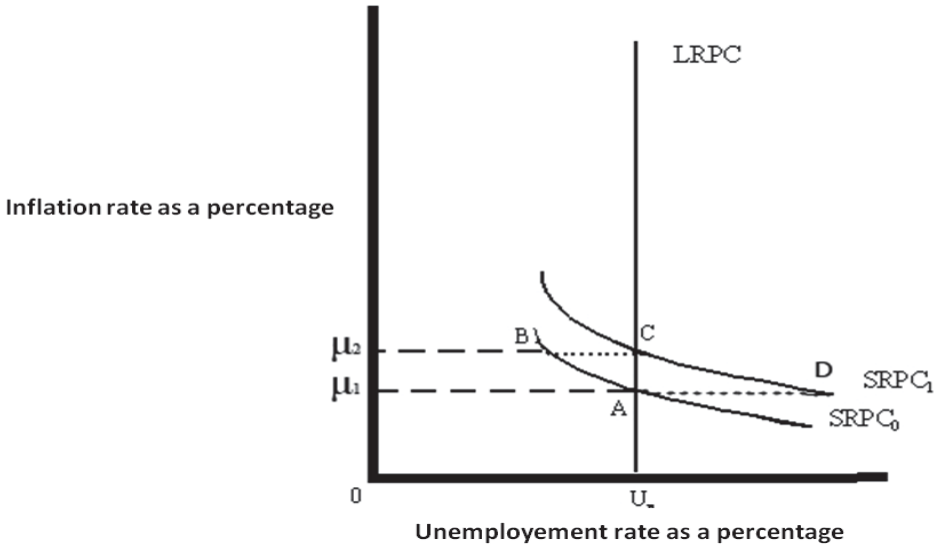


Fig. 2. Phillips curves

According to Friedman (1969, 1976), anticipated inflation is reflected in interest rates so that only unanticipated inflation can affect real interest rates. Sargent (1973) has econometric evidence to support Friedman's view. New Classicals argue that the SRPC is attributable to short-term imperfect information, which decomposes in the long run. Indexed wages, when allowed, result in a limited amount of monetary neutrality and are not enough to gain monetary neutrality for the whole economy (Lucas, 1973; Barro, 1997). Furthermore in capital markets, bond holders and stockholders want real returns accurately adjusted for inflation. A very key part of this idea of the inclusion rates of interest is the fact that the use of variable rate interest loans is certainly widespread in the USA, Canada and the United Kingdom. These three countries provide the historical data of the five papers of Gentle et al. (2005; 2007; 2013) and Chen et al. (2010; 2011). The further widespread use of these variable rate interest

rate loans has increased over time. In the era of relatively fixed and stable mortgage rates Ludwig Von Mises (1963) stressed that interest rates were not being adequately adjusted to reflect inflation.

2.2. Graphic analysis of Phillips curve. Monetarists and New Classicals believe that the Short Run Phillips curve can occur only with unanticipated amounts of inflation (Lucas, 1973; Friedman, 1977). The SRPC may provide a valid description of the supply side of the economy, until all input prices increase proportionately to the output prices. Labor and capital can be substitute or complementary inputs. If the unemployment rate decreases due to more capital, the economy on net, exhibits primarily a complementary relationship. The Phillips curves in Figure 2 are used to develop our model and assume that the economy is initially operating at point A on $SRPC_0$. Then the difference between μ_2 and μ_1, an unanticipated inflation creates a money illusion, which leads the economy to move from point A to point B. When economic agents realize that they failed to accurately anticipate the inflation rate, the agents would make an adjustment. Hence the economy moves to point C on the LRPC. Both temporary misconceptions regarding employees' knowledge of the real wage and entrepreneurs' and managers' knowledge of the real net present value (NPV) allows the economy to operate on a SRPC. (Point D is shown in Figure 2, to show the path of disinflation, if that policy was pursued).

Concurrently entrepreneurs and managers realize the increase in the cost of capital and land, which causes a decrease in the real NPV for capital/labor complementary projects. The increased demand for their products was temporary, caused by a monetary expansion. Then the ability of policy makers to use money illusion to operate on $SRPC_0$ is lost. Therefore, the economy comes back to the natural unemployment rate on the LRPC, due to some workers opting for employment, some capital/labor complementary projects being curtailed, with attendant layoffs and a decrease in aggregate demand that characteristically happens when the real interest rate is increased (Phelps, 1967, 1968; Gentle, 1984; Gentle et al., 1995, 2005, 2007, 2013; Gordon, 2009a; Chen et al., 2010, 2011).

The isocost curves and isoquants in Figure 3 show the effect of a change in the real interest rate on the capital and labor inputs, when capital and labor inputs are used in a complementary way. If the firm is initially operating at point A, the tangent point between the highest isoquant and highest isocost curves in the diagram, this is based upon a set of input costs. If the scenario is where the real wage is constant and the real interest rate increases, then the isocost line will shift inward leading the firm to operate at point B, which produces a lower level of output. An examination of Figure 2 reveals that some firms now reduce both the use of capital inputs due to the higher cost of capital and the use of labor inputs because of less complementary capital input resulted from the lower level of output. Thus the unemployment rate may increase. Steel production is a great example, of where labor and capital can impact the unemployment rate for steel workers. For example, many advanced steel production techniques, including electric ARC technology, create high enough temperatures to make quality steel. These methods make steel production employees more efficient. Some steel is used for the metal frames of buildings. Thus steel workers and construction workers are affected by the interest rate on capital. Our position in all of our papers about Phillips curves has been that all macroeconomic approaches should consider the inclusion of the real rate of interest in Phillips curve analysis.

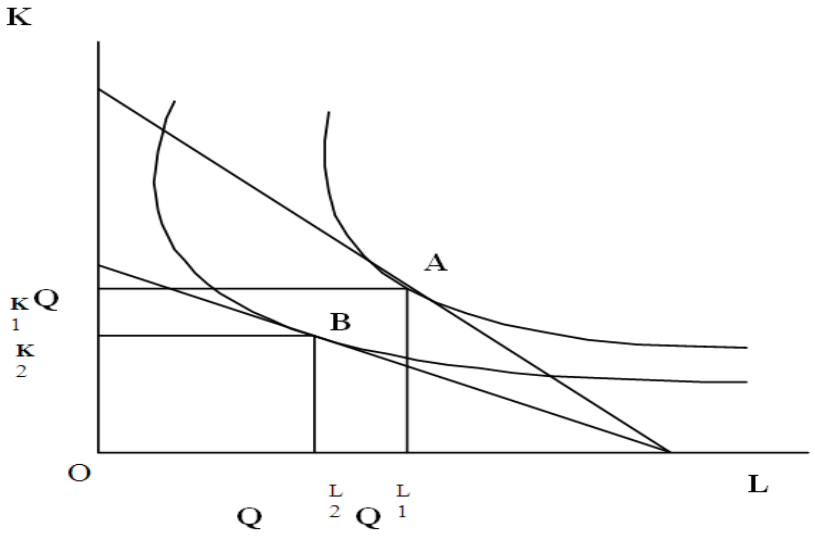


Fig. 3. Isoquant and isocost curves show effects of real interest rate change on capital (K) and labor (L) use

3. Historical examples

Two major economic events examined in this paper are the Great Depression and the recent Housing Bubble. We provide competing dialogues from the mainstream Phillips curve perspective and the Austrian perspective based on Hayekian triangles. Bellante and Garrison (1988) argue, that the two perspectives are complementary. We are also cognizant of the real wage factor in Phillips curve analysis affecting the economy. The key factor for the Phillips curve section is that real interest rates were relatively high, during some years of the Great Depression. The Hayekian triangle explanation stressed the limited ability to ascertain all parts of the money supply, during the Great Depression. For the Philips curve and Hayekian triangle explanations, concerning the housing bubble, both explanations regard the low real inertest rates, as an important factor in the housing bubble. Although we are aware of other economic factors, we have chosen to point out interest rate factors, that occur mainly, during the two periods of economic history, as follows.

3.1. Great Depression – Phillips curve explanation. Friedman and Schwartz (1963) and Meltzer, (1976, 2003) state that unlike the good economic times during part of the 1920s, the "Great Contraction" part of the Great Depression is the period from 1929 to 1933, when the U.S. money supply was most severely reduced, a point agreed upon by some economists (Stiglitz, 2010; Gordon, 2009a). There are economists who emphasize the drop in the velocity of money in the Great Depression. In the year 1933 there was the highest unemployment rate in U.S. history, at 25%. Furthermore, 1932 was the worst year for Canada's unemployment rate, at 30% and the U.K., at 22% (Gordon, 2009a; Great Depression Canada, 2011; Great Depression U.K., 2011). In 1931, the United Kingdom devalued the British pound sterling, which increased British exports and reduced imports and caused a fall in interest rates, in the U.K. (Great Depression U.K., 2011). Several other countries had depreciated their currencies before the U.K. By 1931, all of the British dominions, except for South Africa, had devalued their currency (Eichengreen et al., 1985). The U.S. did not devalue the dollar until 1933, which allowed some of the former demand for U.S. goods to shift to the U.K. Per some economists, the deflation in the US increasing unemployment. Eichengreen (1992) and Mishkin (2010) state that in spite of the various debates about monetary policy, concerning the most severe part of the Great Depression, the salient point to consider is that the real rate of interest was high, with a concomitant slowing of the economy. In this paper, we are concerned with both the real wage rate and real interest rate being key causal variables. Point D in Figure 2 shows a positive inflation rate. When there is deflation, the economy is operating at points to the right of the LRPC, below the horizontal axis of Figure 2.

3.2. Great Depression – Hayekian triangles explanation. The most comprehensive Austrian treatments of the Great Depression are by Robbins (1934) and Rothbard (1962). They indicate, with respect to the American case, that the central bank embarked on an expansionary monetary policy from mid-1921 to the end of 1928. The Federal Reserve was indeed quite active during this period. This can be seen in the monetary aggregates it most closely controlled and by the fact that its discount rate policy was expansionary in that the rate it set was as a truly "discount" rate rather than a penalty rate. This clearly indicates that interest rates were held below market determined levels, by the central bank. This can also be seen in money supply data. According to Rothbard (1962) and Salerno (1999) the US money supply between mid-1921 and the end of 1928 increased at an annual rate of 8.1%. During this period "uncontrolled reserves" decreased by $1.430 billion and "controlled reserved" increased by $2.217 billion. As a result, reserves controlled by the Fed increased by 138% or 18.4% per year, while reserves not controlled by the Fed fell by almost 12% per year. The fact that reserves controlled by the Fed increased is a clear indication that the inflation of the money supply was the intention of the central bank. The most likely explanation for this policy was to create a negative balance of trade with the U.K. which would cause a positive gold (and jobs) flow to that beleaguered ally, still recovering from the adjustments to the aftermath of World War I.

Whatever the intent, the effect was to produce a classic example of the Hayekian triangle in action. The artificially low interest rates and increased money supply did not just create more investment and a general boom in the economy, but a very different structure of production, new products, and longer run investment in both the private and public sectors. This change in structure is aptly described as "mass production" of technological products. Prior to WWI automobiles were often made one at a time, but in the 1920s the assembly line dominated with interchangeable parts shipped in from various suppliers. This technique was more roundabout and time consuming, but ultimately meant greater efficiency and lower cost. In addition to automobiles, there were radio, phonographs, motion pictures, and many other new products. Carter (2006) indicates that GDP in the U.S. was about 15% above trend levels in 1929. GDP then turns down and remains below trend from 1930 to 1936. Therefore, Garrison (2002) is highly credible when he labels the 1920s as a period of Fed-induced period of malinvestment and misallocation of resources. He argues there was an artificial boom

and pivot of the Hayekian triangle towards a longer structure of production (hypotenuse shifts out) and increased consumption (vertical axis moves up) which was unsustainable (hypotenuse collapses).

Garrison (2001) also shows these shifts in the Hayekian triangle on the Production Possibility Frontier (PPF) as a temporary movement outside the PPF and then a collapse inside the PPF, perhaps with shrinkage of the PPF if capital values are diminished. In the Austrian model, the contraction should be expected if the expansion was based on artificially reduced interest rates – the bust is the inevitable result of the boom. The bust is inevitable because entrepreneurs made malinvestments in the boom. As investments are constructed there are not enough resources to complete all the projects as planned and this increases the cost of such projects as entrepreneurs compete for resources. Once the projects are completed and new production is brought online we find that more output is available than anticipated and savers have not added to their savings so output prices fall below what entrepreneurs had projected. The final result is an environment of higher costs, lower prices, and more competitors than anticipated when investment plans were made during the boom.

Thornton (2008) makes the salient point when he demonstrates that Ludwig von Mises, Hayek, and several other economists of the Austrian school correctly anticipated the Great depression. It appears some others such as Irving Fisher may not have anticipated the stock market crash of 1929. Austrians in contrast blame the Great Depression on the formation of the Fed, the adoption of a Gold Exchange Standard System, and the Fed policy in the 1920s of mimicking Irving Fisher's proposal for monetary policy to be guided by the idea of a stable dollar. Austrians also point to the fact that the Fed followed a strong expansionary policy in the early 1930s and greatly increased the bank reserves that it could control, but they were swamped by loses in bank reserves that they could not control (Garrison, 1989).

3.3. Housing bubble – Phillips curve explanation. A temporary deviation on the left side of the LRPC to a SRPC can illustrate the effects of an expansionary monetary policy causing increased activity in the economy, including in housing construction, until the "housing bubble broke". The U.S. was already increasing the money supply as a strategy to get past the effects of a recession between March and November 2001. The ending of the dot.com boom resulted in falling stock market prices and higher unemployment. Corporate scandals such as those that happened in Enron and Anderson also had an adverse effect on the economy (Graham et al., 2002; Bernanke, 2010). Because of these factors and because of the terrorist attacks on the USA soil on September 11, 2001, the Fed over-reacted in a producing a great monetary expansion, that was not even guided by the Taylor Rule (Bernanke, 2010; Koenig et al., 2012). Thus the resulting inflation had an effect on the housing market. With so much credit available, lending authorities sometimes ignored normal loan procedures of thoroughly vetting a mortgage customer, with such loans referred to as subprime. It must be remembered that there are two parts of a housing payment – interest and principle (Taylor, 2009). Greenspan (2010) mentions that housing prices were high leading up to the bubble burst and downplays low interest rates having an effect. As Taylor (2009) points out, housing prices went up but the real rate of interest was relatively low for a time and that is why so many houses were purchased. Another factor, one that Greenspan admits to is that with so much credit available, lending authorities sometimes ignored normal loan procedures of thoroughly vetting a mortgage customer, with such loans referred to as subprime. It must be remembered that there are two parts of a housing payment – interest and principle. Yes, housing prices went up but the real rate of interest was relatively low for a time and so many houses were purchased. With the expectation that house prices would continue to increase, mortgage buyers and lenders were willing to continue that strategy. As long the home's price inflation increased to higher levels, a person's home in actual re-sales value was worth more than the original mortgage loan and could be refinanced. However, continual high appreciation eventually came to an end (Gordon, 2009a). Some economists, predicted the housing bubble, that eventually burst in 2007 (Thornton, 2004a, 2004c; Baker, 2013; Roubini, 2013). The resulting fall in housing prices, with concomitant unemployment rate increase, resulted in the economy operating on a SRPC on the right side of the LRPC. In 2001, in the USA, there were 1.6 million housing starts; in 2005 there were 2.1 million housing starts; in 2007 there were 1.5 million housing starts. The USA stock market crashed in October, 2008 and is attributable to the bursting of the bubble in the housing market (Gordon, 2009a; Stiglitz, 2010).

So in terms of the Phillips curve, the U.S. economy expanded, to a point on a SRPC to the left of the LRPC. Once the housing bubble broke, the U.S. economy would go to a point to the right of the LRPC on a SRPC. An example of an adversely affected financial institution is Lehman Brothers with holdings of over 600 billion U.S. dollars. Lehman Brothers filed for Chapter 11 bankruptcy protection (used by businesses) on September 15, 2008. This remains at this time, "the largest bankruptcy filing in U.S. history". (Lehman, 2012). Perri et al. (2011) suggest that "credit disturbances could have played a central role in the 2007-2009 crises". A key fact is

that although there were contractions in real GDP among the G7 countries, the United States especially was affected with an increase in unemployment and the worst recession in postwar times (Ohanian, 2010; Perri et al., 2011).

The U.S. mortgage-backed securities were marketed around the world. The danger was that the risk was not being determined in a reliable way. "A more broad based credit boom fed a global speculative bubble in real estate" (Late, 2012). C. Jones and Masters (2011) state that according to research by the UK Financial Services Authority, the Bank of England, should have the power to limit mortgages, mandate tougher liquidity rules and put a cap on banks' leverage in order to help prevent future financial crises. Northern Rock had to be helped by the Bank of England, due to a weak portfolio (Shin, 2009; Northern Rock, 2012a, 2012b).

Because the mortgage markets are different in Canada, the mortgage markets were less affected by sub-prime loans, in comparison to the U.S. and the U.K., during the period of 2008-2009 according to Freeland (2010). In a conference at the Federal Reserve Bank of Cleveland, Virginia Traclet stated that mortgage interest not being deductible and greater recourse in going after other assets besides a house, in the event of default. Possibly this results in more circumspect decisions about buying a home. This according to some economists is the reason that Canada did not experienced the housing bubble and burst, when the USA did (Kiff, 2009; Hagerty, 2010). Nonetheless, some time later, in early 2014, Mathews (2014) and Mattich (2014) warn that a housing bubble seems to be present now in Canada and if that bubble breaks, it may not be a soft landing.

3.4 Housing bubble – Hayekian triangles explanation. In the wake of the Tech/dot.com bubble the Fed began to lower the federal funds rate to 1%. It kept rates low and did not increase the federal funds rate until 2004 which by that time several Austrian economists had already detected the Housing Bubble (Thornton, 2004c; Thornton, 2006; Thornton, 2009). During this time period there were big increases in the money supply, the amount of credit issued by financial firms, and the number of new houses built. The reasons that so many resources were funneled into housing, rather than more generally is attributable to enhanced tax breaks for housing, the Community Reinvestment Act, and Fannie Mae and Freddie Mac. These factors all helped to reduce lending standards and increase the flow of credit to housing. It seems that the reduction of the federal funds rate was a classic case of the central bank reducing interest rates to artificially low levels that were below what would have happened in the absence of intervention. Mortgage rates fell along with the federal funds rates. The just reviewed Phillips curve take on the Housing Bubble, counters Greenspan's comments about housing prices. Another way of responding to Greenspan is that lower mortgage rates reduce the full price of housing and that increases the quantity demanded.

The structural change in the economy was a movement towards the production of this long run durable consumer good – housing – and all its inputs and taken away from shorter term oriented consumption goods – manufacturing. Employment patterns followed this trend.

Economists categorize stocks and residential housing are part of the investment and investment is affected by interest rate changes. The rate on conventional 30 year mortgages bottomed in 2003 and began a slow assent higher. The Fed started raising rates on the federal funds rate in 2004. This brought the housing bubble to a standstill in 2006. However, too many housing units had already been built and too many mortgages had already been issued on the faith of ever rising home prices. As home prices began to fall, mortgages with teaser rates became vulnerable because they were only viable for the time of the teaser payments and the ability to refinance the mortgage.

What was largely thought of as impossible was now revealed as inevitable. The initial decrease in interest rates shifted the Hayekian triangle from the production of short-term consumer goods to the production of longer term consumer durables, i.e. housing. As prices and interest rates started to rise the bubble could not be maintain and collapsed. The value of the housing construction infrastructure also collapsed. The Fed did respond as it did during the Great Depression with ZIRP and QE, but they have only been able to freeze the crisis in place, not to provide a return to prosperity.

4. Econometric evidence

Gentle et al. (2005, 2007, 2013) and Chen and Gentle (2010, 2011) employ different econometric methodologies based on different countries over different sample periods to perform statistical tests on the Phillips curve model which includes real wage and real interest rate. Reviewing those many pages is beyond the scope of this paper. The fact that the real interest rate variable is statistically significant and that including it in models adds explanatory power is a good indication that (1) Hayekian triangles and Phillips curve are complementary tools, (2) the combination of variables improves empirical results, and (3) the combination of variables enhances our ability to describe actual business cycles because now we can add capital to that discussion and even describe the types of changes that occur to different types of capital over the business cycle.

Summary and conclusion

Bellante and Garrison (1988) wrote about the conventional Phillips curve. The models in the five eco-

nometric papers are from that but augmented with the real interest rate variable (Gentle et al., 2005, 2007, 2013; and Chen, 2010, 2011). Bellante and Garrison (1988) show that the Hayekian triangle and the Phillips curve should be understood as complements. Bellante and Garrison (1988) did not appear to be writing about Ravier's (2013) Austrian Phillips Curve, which is in this paper's Appendix (A more detailed analysis of Ravier 2013 is beyond the scope of this paper, due to space limitations). We have summarized econometric work, based on conventional Phillips curves augmented with the real interest rate variable, in order to ask economists to consider adding that variable to the Phillips curve analysis.

We have also presented the case for the use of Hayekian triangles in looking at economic historical events. The author's intent of this paper is to provide a springboard for discussion of both Hayekian triangles and the Phillip's curve, with real interest as a variable. We conclude that both the Phillips curve, with the real interest rate variable added and Hayekian triangles can be used together in explaining business cycles[1].

References

1. Baker, Dean "Dean Baker" (2013). Available at http://en.wikipedia.org/wiki/Dean_Baker, January 31.
2. Bank of Canada (2010). Charting Change: 1935-2010: Canada's Economy since the Founding of the Bank of Canada, April 16. Available at http://www.bankofcanada.ca/en/about/pdf/chart_media_75years.pdf.
3. Barro, R.J. (1997). Long-Term Contracting, Sticky Prices, and Monetary Policy, *Journal of Monetary Economics*, 3 (3), pp. 305-316.
4. Bellante, D. and Garrison, R. (1988). Phillips Curves and Hayekian Triangles, *History of Political Economy*, 20 (2), pp. 207-233.
5. Bernanke, B. (2010). Monetary Policy and the Housing Bubble, *Annual Meeting of the American Economic Association*, Atlanta, Georgia, January 3.
6. Carlin, Wendy and David Soskice (2006). *Macroeconomics: Imperfections*, *Institutions and Policies*, Oxford: Oxford University Press.
7. Carter, Susan (2006). *Historical Statistics of America: Millennial Edition*, Series Ca9.
8. Chen, Tao, Paul F. Gentle and Kamal Upadhyaya (2010). The Inflation-Unemployment Trade-off and the Significance of the Interest Rate: Some Evidence from the United Kingdom, *Banks and Bank Systems*, 5 (1), March, pp. 87-91.
9. Chen, Tao and Paul F. Gentle (2011). "The Inflation-Unemployment Trade-off and the Significance of the Interest Rate: Some Evidence from United States Data from 1939 through 2007, *Economia Internazionale*, 54 (2), May, pp. 153-171.
10. Dornbusch, R., Fisher, S. and Startz, R. (1998). *Macroeconomics*, New York: Irwin McGraw-Hill.
11. Economic History of UK (2012). January 2. Available at http://en.wikipedia.org/wiki/Economic_history_of_the_United_Kingdom.
12. Eichengreen, Barry and Jeffrey Sachs (1985). Exchange Rates and Economic Recovery in the 1930s, *The Journal of Economic History*, 45 (4), December, pp. 925-946.
13. Eichengreen, B. (1992). The origins and nature of the Great Slump revisited, *The Economic History Review*, 45 (2), May, pp. 213-239.
14. Englund, Eric (2005). "When Will America's Housing Bubble Burst?" LewRockwell.com, November 4.
15. Freeland, Chrystia (2010). What Toronto can Teach New York and London, *Financial Times Magazine*, January 29, 2010. http://www.ft.com/intl/cms/s/0/db2b340a-0a1b-11df-8b23-00144feabdc0.html.
16. Friedman, M. and Anna J. Schwartz (1963). *A Monetary History of the United States*, *1867-1960*, Princeton, New Jersey: Princeton University Press.
17. Friedman, M. (1968). The Role of Monetary Policy, *American Economic Review*, 58 (1), pp. 1-17.
18. Friedman, M. (1969). The Supply of Money and Changes in Prices and Output, *The Optimum Quantity of Money and Other Essays*, Chicago: Aldine Publishing, Co.
19. Friedman, M. (1976). *Price Theory*, Chicago: Aldine Publishing, Co.
20. Friedman, M. (1977). Nobel Lecture: Inflation and Unemployment, *Journal of Political Economy*, 85 (3), pp. 451-472.
21. Garrison, Roger W. (1989). The Austrian Theory of the Business Cycle in Light of Modern Macroeconomics, *Review of Austrian Economics*, 3, pp. 3-29.
22. Garrison, Roger W. (1994). Hayekian Triangles and Beyond, *Hayek*, *Coordinator and Evolution: His Legacy in Philosophy*, *Politics*, *Economics and the History of Ideas*, London: Routledge, pp. 109-125.
23. Garrison, Roger (2001). *Time and Money*, *The Macroeconomics of Capital Structure*, London: Routledge.
24. Garrison, Roger W. (2002). Business Cycles: Austrian Approach, in Howard Vane and Brian Snowdon (eds.), *An Encyclopedia of Macroeconomics*, Northampton, Massachusetts, USA: Edward Elgar.
25. Gentle, Paul F. (1984). Essay on Evening Seminars, including the Phillips curve Fall, 1983-Spring, 1984, Auburn University, M.S. student, Summer. (This and other graduate term papers, on the topic, of Phillips Curves, were written through 1989 at Samford University and from 1992-1993, as a Ph.D. student).

[1] Please see the Appendix for an alternative Austrian Phillips curve. The authors wish to thank Tao Chen, Yuxi Luo and Jonathan Newman for helpful comments.

26. Gentle, Paul F. and James Novak (1995). Capital Effects and Money Illusion: An Additional Reason for the Existence of Short Run and Long Phillips Curves, paper completed Auburn University, Spring.
27. Gentle, P.F., Paudel K.P., and Upadhyaya K.P. (2005). Real Wages, Real Interest and the Phillips Curve, *Applied Economics*, 37 (4), pp. 397-402.
28. Gentle, Paul F., Krishna Paudel and Kamal Upadhyaya (2007). Real Wages, Real Interest Rates and the Phillips Curve: Evidence from Canadian Data, *International Economics*, 60 (3), August, pp. 319-332.
29. Gentle, Paul F., and Tao Chen (2013). The significance of real interest and real wages in the temporary inflation-unemployment trade-off: some evidence from Canadian data from 1935 through 2010, *Banks and Bank Systems*, 9 (2), pp. 61-71.
30. Golosov, M. and R.E. Lucas (2007). Menu Costs and Phillips Curves, *Journal of Political Economy*, 115 (2), pp. 171-199.
31. Gordon, R.J. (1990). What is New-Keynesian Economics? *Journal of Economic Literature*, 28 (3), pp. 1115-1171.
32. Gordon, R.J. (2009a). *Macroeconomics*, Eleventh Edition, Hong Kong, China: Pearson Education Asia, Addison Wesley.
33. Gordon, R.J. (2009b). The History of the Phillips Curve: Consensus and Bifurification, *Economica*, September 12, pp. 1115-1171.
34. Graham, C. and R.E. Litan and S. Sukhtankar (2002). The Bigger they are, the Harder they Fall: An Estimate of the crises in Corporate Governance, *The Brookings Institution Working Paper*, August 30. Great Depression of Canada (2011). April 15. Available at http://en.wikipedia.org/wiki/Great_Depression_in_Canada.
35. Great Depression UK (2011). August 15. Available at http://en.wikipedia.org/wiki/Great_Depression_in_the_United_Kingdom.
36. Greenspan, Alan (2010). The Crises, *Brookings Paper on Economic Activity*, Spring, pp. 201-261. Available at http://www.brookings.edu/~/media/projects/bpea/spring%202010/2010a_bpea_greenspan.pdf.
37. Hagerty, James (2010). Oh, Canada! What We Could Learn From Your Mortgage Market, The Wall Street Journal, June 10. Available at http://blogs.wsj.com/developments/2010/06/10/oh-canada-what-we-could-learn-from-your-mortgage-market/.
38. Hayek, F.A. (1935). Prices and Production, 2nd edition, New York: Augustus M. Kelly (1st edition published in 1931; 2nd edition published in 1935, reprinted in 1967).
39. Hayek, Friedrich A. (1979). *Unemployment and Monetary Policy*, Washington, D.C.: Cato Institute.
40. Jones, Claire and Brooke Masters (2011). Research suggests ways to avoid crises, *Financial Times*, December 20. Available at http://www.ft.com/intl/cms/s/0/14349542-2b04-11e1-8a38-00144feabdc0.html#axzz1oJLjtiQ1.
41. Kiff, John (2009). Canadian Residential Mortgage markets: Boring But Effective, *IMF Working Paper*, *Monetary and Capital Markets*, June 1.
42. Keonig, Even F., Robert Leeson and George A. Kahn (2102). *The Taylor Rule and the Transformation of Monetary Policy*, Stanford, CA, USA: Hoover Institute Press.
43. Late (2012). Late 2000s Recession. Available at http://en.wikipedia.org/wiki/Late-2000s_recession#cite_note-15 March 25.
44. Lehman (2012). Bankruptcy of Lehman Brothers. Available at http://en.wikipedia. org/wiki/Bankruptcy_of_Lehman_Brothers, March 20.
45. Lucas, R.E. (1973). Some International Evidence on Output-Inflation Trade-Offs, *American Economic Review*, 63 (3), pp. 326-334.
46. Mankiw, N.G. (2006). *Macroeconomics*, sixth edition, New York: Worth Publishers, Inc.
47. Matthews, Christopher (2014). Canada has its own Housing Bubble and it's about to Burst, *Time*, January 17, Available at http://business.time.com/2014/01/17/canada-has-its-own-housing-bubble-and-its-about-to-burst/.
48. Mattich, Alen (2014). Is the Canadian Miracle a Postponed reckoning, *Wall Street Journal*. Available at http://blogs.wsj.com/moneybeat/2014/01/14/canadas-skidding/
49. Meltzer, Allan (1995). Monetary and Other Explanations for the start of the Great Depression, *Journal of Monetary Economics*, 2, pp. 455-472.
50. Meltzer, Allan H. (2003). *A History of the Federal Reserve*, Chicago: University of Chicago Press, Volume 1, pp. 1913-1951.
51. Mishkin, F.S. (2010). *The Economics of Money*, *Banking, and Financial Markets*, 9th ed., Hong Kong: Pearson Addison Wesley Press.
52. Northern Rock (2012a). Northern Rock. Available at http://en.wikipedia.org/wiki/Northern_Rock, March 11, 2012.
53. Northern Rock (2012b). Northern Rock Asset Management. Available at http://en.wikipedia.org/wiki/Northern_Rock (Asset_Management) March 11, 2012
54. Ohanian, Lee E. (2010). The Economic Crises from a Neo classical Perspective, *Journal of Economic Perspectives*, 22 (4), pp. 45-66.
55. Perri, Fabrazio and Vincenzo Quadrini (2011). International Recessions, *NBER Working Papers 17201*, *National Bureau of Economic Research*, July, 2011.
56. Perry, Mark J. (2010). Due North: Marvelous Mortgage and Banking System, The American, February 26. Available at http://www.american.com/archive/2010/february/due-north-canadas-marvelous-mortgage-and-banking-system.
57. Phelps, Edmund S. (1967). Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time, *Economica*, 34, pp. 254-281.

58. Phelps, Edmund S. (1968). Money Wage Dynamics and Labor-Market Dynamics and Labor-Market Equilibrium, *Journal of Political Economy*, 76, July/August 4 (2), pp. 678-711.
59. Ravier, Adrian O. (2013). "Dynamic Monetary Theory and the Phillips curve with a Positive Slope", *Quarterly Journal of Austrian Economics*, 16 (2), Summer, pp. 165-186.
60. Robbins, Lionel. (1934). *The Great Depression*, London: Macmillan.
61. Roubini, Nouriel (2013). Nouriel Roubini. Available at http://en.wikipedia.org/wiki/Roubini, January 31.
62. Rothbard, Murray N. (1962). *America's Great Depression*, New York: Richardson & Snyder.
63. Santomero, A.M., and Seater J.J. (1978). The Inflation-Unemployment Trade-off: A Critique of the Literature, *Journal of Economic Literature*, 16 (2), pp. 499-544.
64. Sargent, T.J. (1973). Rational Expectations, the Real Rate of Interest, and the Natural Rate of Unemployment, Brookings Papers on Economy Activity, 2, pp. 429-472.
65. Sargent, Thomas (1979). The Phillips Curve, *Macroeconomic Theory*, New York: Academic Press, pp. 324-332.
66. Sargent, T.J. (1999). *The Conquest of American Inflation*, Princeton, N.J.: Princeton University Press.
67. Shin, Hyun Song (2009). Reflections on Northern Rock: The Bank Run that Heralded the Global Financial Crises, *Journal of Economic Perspectives*, 23 (1), pp. 101-119.
68. Salerno, Joseph T. (1999). Money and Gold in the 1920s and 1930s: An Austrian View, *The Freeman: Ideas on Liberty*, Vol. 49 (October). Available at http://www.fee.org/the_freeman/detail/money-and-gold-in-the-1920s-and-1930s-an-austrian-view/#axzz2sMtWOpGp.
69. Snowdon, B. Brian and Howard R. Vane (2005). *Modern Macroeconomics: Its Origins, Development and Current State*, Cheltenham, U.K.: Edward Elgar.
70. Stglitz, J.E. (2010). *The Stiglitz Report: Reforming the International Monetary and Financial Systems in the Wake of the Global Crises*, New York: The New Press.
71. Taylor, J.B. (1980). Aggregate Dynamics and Staggered Contracts, *Journal of Political Economy*, 88 (1), pp. 1-23.
72. Taylor, John M. (2009). *Getting of Track: How Government Actions and Interventions Caused, Prolonged, and Worsened the Financial Crises*, Stanford, CA: Stanford University Hoover Institute.
73. Thornton, M. (2004a). Bull' Market? LewRockwell.com. Available at http://www.lewrockwell.com/2004/02/mark-thornton/bull-market/, February 9.
74. Thornton, M. (2004b). New Economists and the Great Depression of the 1970s, *Mises Daily*, May 7. Available at http://mises.org/daily/1507, May 7.
75. Thornton, M. (2004c). Housing: Too Good To be True? *Mises Daily Article*, June 4, 2004.
76. Thornton, M. (2006). The Economics of Housing Bubbles, *Working Paper*, *Ludwig von Mises Institute*, Published as Thornton.
77. Thornton, M. (2009). The Economics of Housing Bubbles, in Randall Holcombe and Benjamin Powell edited *Housing America: Building Out of a Crisis*, Independent Institute, pp. 237-262.
78. Thornton, M. (2008). The Great Depression: Mises versus Fisher, *Quarterly Journal of Austrian Economics*, 11, November, pp. 230-241.
79. Von Mises, Ludwig (1912, 1934). *Theory of Money and Credit*, London: Jonathan Cape Ltd.
80. Von Mises, Ludwig (1963). *Human Action: A Treatise on Economics*, revised ed., New Haven, CT: Yale University Press.

Appendix

Ravier (2013) suggests that an Austrian Phillips curve could appear as this diagram, below. An important part of his diagram is to not include a SRPC and a LRPC, comparable to what is shown in Figure 2 of this paper. The Phillips curves that we are looking at in the body of this article does include the concepts of an SRPC and an LRPC. His graph indicates that unemployment can be a problem when there is deflation. He also shows the highest point of stagflation on point G. More discussion about this alternative Phillips curve, can be found in Ravier (2013).

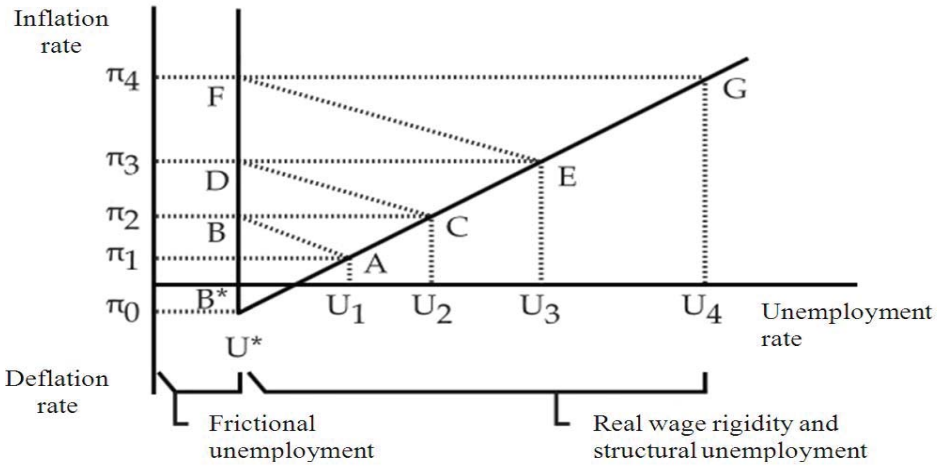


Fig. 1a. Austrian Phillips curve