How to Recover From the Great Recession: The Case of a Two-Sector Small Open Economy with Traded and Non-Traded Capital

Jong-Kyou Jeon
College of International Studies
Kyung Hee University
jkjeon@khu.ac.kr

Since the global financial crisis in 2008, the world economy has been suffering from the Great Recession characterized by high and persistent unemployment as well as drastic fall in asset prices. Real business cycle theory or new-Keynesian economics which has been the dominant paradigm in macroeconomics for the last four decades is unable to explain the high and persistent unemployment during the Great Recession. This implies that the economics of Keynes should be taken seriously again as a tool to explain the Great Recession. Farmer (2012) proposes a new way of interpreting the economics of Keynes by providing it with a solid micro-foundation based on labor markets with search. According to Farmer (2012), aggregate economic activity independently depends on the long-term self-fulfilling expectations about the stock prices. As a consequence, the government or the central bank should implement a policy that influences the public's confidence about the stock market. For an open economy like the Korean economy, it is not only stock price but also the price of asset such as house that matters more for the aggregate economic activity. Households in the Korean economy hold more than 70 percent of their wealth in the form of real estate asset, especially housing asset. This makes the public's confidence about the future prices of houses even more important in explaining the business cycles of the Korean economy. Policymakers should implement policies to improve the confidence of households about the housing market to recover from the recession caused by a fall in house prices. Little theoretical work has been done in explaining fluctuations in the aggregate economic activity from the point of house prices. This paper develops a small open economy model with traded and non-traded capital based on Farmer (2012) and shows that the aggregate economic activity also independently depends on the households' self-fulfilling expectations about the future prices of non-traded asset such as houses.

Keywords: Great Recession, Economics of Keynes, Self-fulfilling Beliefs, Non-Traded Capital
JEL Classification: E30, F00, F44

I. Introduction

Since the global financial crisis was triggered by the breakdown of U.S. subprime mortgage market in 2008, the world economy has been suffering from the stagnated growth and massive increase in unemployment. Increase in unemployment is especially notable in the U.S. and EU area. Economists call this stagnation the Great Recession in the sense that it is the worst recession ever happened after the Great Depression in the 1930s.

Economic event such as the Great Depression has a profound influence on the framework in which economists view the economy. Broadly speaking, there were two major events in the twentieth century, each of which brought out paradigm shifts in the field of macroeconomics. The first is the Great Depression in the 1930s. Before the Great Depression, classical economics was the major paradigm in which economists analyzed the economy. As widely known, the main theme of classical economics is the idea that the economy is an efficient self-regulating system guided by an invisible hand. In the world of classical economics, the economy hit by a shock, if left undisturbed by government or any other authority, would quickly return to its full employment. But the immense human misery caused by high and persistent unemployment during the Great Depression made Keynes disagree with the classical view and proposed a new way of macroeconomic thinking in which he stressed the role of government and animal spirits of investors to have the economy escape from the recession. Great Depression gave birth to the economics of Keynes. The second event is the stagflation in the 1970s. Stagflation discredited the Phillips curve which was embraced by Keynesian economists as empirical evidence in support of Keynesian economics. The Phillips curve was replaced by the natural rate hypothesis argued by Phelps (1968) and Friedman (1968). Keynesian economics was replaced by the classical economics revived by Lucas (1972) who initiated the rational expectations revolution.

The global financial crisis of 2008 seems to be the third event that demands a new approach to understand the Great Recession. The value of worldwide assets plummeted after the Lehman Brothers collapsed in September 2008. For instance, S&P 500 fell by 33.8 percent between September 2008 and February 2009. The value of housing assets also decreased significantly. House prices in the U.S. dropped by 34.2 percent between April, 2006 and January 2012. Unemployment rate rose rapidly. It was only 4.4 percent in May 2007, but reached 10 percent in October 2009. Sudden loss in asset prices and persistent

increase in unemployment are two striking features of the crash of 2008. These features are hardly accounted for by real business cycle model or new-Keynesian economics which has been the dominant paradigm in academics as well as for policymakers over the last four decades.

Economic fluctuations occur in real business cycle model or new-Keynesian economics only when the fundamentals of the economy are disturbed. For example, employment fluctuates when we have underlying changes in household preferences for leisure or shocks to the technology of production, etc. In response to changes in the fundamentals of the economy, individuals forming rational expectations are able to figure out best decisions about how much they consume and how long they work by solving the problem of dynamic optimization. There is no involuntary unemployment in these models, and all variations in employment are nothing but voluntary variations in the number of hours worked that rational individuals choose. This implies, in fact, that in these models there are no candidate shocks capable of causing such drastic fluctuations as we have seen in the Great Depression or Great Recession. Shocks that caused the Great Depression or Great Recession are inconsistent with the natural rate hypothesis because natural rate is determined by the fundamentals of the economy, and the fundamentals in general do not change much in the short run. We can hardly think of any changes in the fundamentals of the economy big enough to justify the sudden 5.6 percentage point increase of unemployment rate just over the period of two years. Economy can deviate away from the natural rate temporarily, but reverts quickly back to the natural rate in the real business cycle or the new-Keynesian model.[1]

The financial crisis of 2008 in the U.S. was certainly caused by sudden and huge losses in confidence of investors about asset prices when investors realized that their money invested in subprime mortgage-related derivatives were no longer safe. This led to stock market collapse in 2008. House prices also fell significantly. In fact, house prices had already been falling down since the early 2006. Two major asset prices, stock prices and house prices, dropped precipitously, which means that aggregate demand collapsed due to severe negative wealth effects. Serious fall in aggregate demand resulted in big increase in unemployment. This is how the Great Recession prevailed. Therefore, a new

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[1] New-Keynesian models are theoretically capable of displaying high unemployment rate for very long periods of time. However, when they are calibrated to realistic numbers for the speed of price adjustment, new-Keynesian models imply that the unemployment rate quickly reverts to its natural rate once it deviates away from it.

approach that we need to explain the Great Recession should embrace changes in confidence of investors about asset prices as an independent driving force for business fluctuations. In other words, confidence of investors about asset prices should be taken as one of the fundamentals of the economy. However, changes in confidence of investors are regarded only as random disturbances to the fundamentals of the economy in real business cycle model and new-Keynesian economics.

Keynes (1936) argued that aggregate economic activity is determined by the "animal spirits" of investors. According to Keynes, the main impulse that caused the Great Depression was spontaneous deteriorations in confidence of investors about the future. By "animal spirits", he meant an irrational mass hysteria that influences all stock market investors simultaneously. Keynes (1936) takes "animal spirits" or confidence of investors as an independent driving force of business cycles. Confidence of investors is one of the fundamentals of the economy in the economics of Keynes. Thus, now the time has come for economists to bring the economics of Keynes back to life.

We note that what economists should bring back is the economics of Keynes, not Keynesian economics. The central argument of Keynesian economics is well summarized by the neoclassical synthesis introduced by Samuelson (1955). The neoclassical synthesis argues that the economy is Keynesian in the short run when prices have not yet fully adjusted, but classical in the long run when price adjustments have run their course. Keynesian economists reinterpreted and reorganized *The General Theory* by incorporating the idea of sticky prices with Keynes's idea of effective demand. For Keynesian economists, involuntary unemployment exists in the short run because there is an excess supply of labor caused by current wages being not yet fully adjusted to their equilibrium level. For Keynesian economists, the market system still works. It only works poor in the short run because prices do not have a chance to adjust to the level that would equate the quantity demanded with the quantity supplied. When all prices adjust to the equilibrium level in the long run, the market works perfectly as in the classical economics. However, Keynes viewed that markets have no or very weak mechanism to adjust the gap between the demand and the supply. For Keynes, involuntary unemployment exists not because the money wage is sticky in the short run, but because labor market has no mechanism to adjust the gap between labor demand and labor supply.[2] Leijonhufvud (1966) clarified

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[2] Regarding the labor market Keynes argues:
  The traditional theory maintains, in short, that the wage bargains between the entrepreneurs and

this point that the economics of Keynes was never about "sticky prices."

One serious weakness in the economics of Keynes is that it lacks a micro-foundation. However, the economics of Keynes can be given a solid micro-foundation if it is combined with analytical tools of the rational expectations model first developed by Lucas and Rapping (1969) and Lucas (1972). The rational expectations revolution has provided us with a very sophisticated mathematical way of analyzing the macroeconomic consequences of rational choices made by individuals who maximize their utilities dynamically. Farmer (2012) proposes an excellent approach in this regard to give the economics of Keynes a micro-foundation.

Farmer (2012) integrates two key ideas in *The General Theory* with dynamic general equilibrium model. The first idea is that involuntary unemployment can persist because labor market lacks the self-adjusting mechanism. The second idea is that aggregate economic activity is determined by the "animal spirits" of investors. In order to capture these ideas in dynamic general equilibrium framework, Farmer (2012) relies on the search-theoretic models of labor market. Labor search models are often known to have multiple equilibria as pointed by Diamond (1982, 1984).[3] In order to deal with multiple equilibria, labor search models add an equation based on preferences, technology and endowments. Nash bargaining solution is the most common way of dealing with indeterminacy in labor search models.[4] Instead of searching for an additional fundamental equation in labor search model, Farmer (2012) closed the model with an equation describing how the self-fulfilling beliefs are formed. This opens the way in

the workers determine the real wage: so that assuming free competition amongst employers and no restrictive combination amongst workers, the latter can, if they wish, bring their real wages into conformity with the marginal disutility of the amount of employment offered by the employers at that wage. If this is not true, then there is no longer any reason to expect a tendency towards equality between the real wage and the marginal disutility of labor⋯.

⋯For there may be no method available to labor as a whole whereby it can bring the wage-goods equivalent of the general level of money wages into conformity with the marginal disutility of the current volume of employment. There may exist no expedient by which labor as a whole can reduce its real wage to a given figure by making revised money bargains with the entrepreneurs. (Keynes, 1936, Chapter 2)

[3] Labor search models in general lacks one equation to determine the equilibrium level of employment because they do not have a frictionless labor market as in real business cycle model or specific wage-setting process as in new-Keynesian economics.

[4] Nash bargaining solution allocates rents between a firm and a worker by assuming a fixed bargaining weight. However, Shimer (2005) showed that Nash bargaining solution produces very small fluctuations in unemployment, relative to data, if the model is disturbed by productivity shocks.

which "animal spirits" or confidences of investors are explicitly incorporated into dynamic general equilibrium theory and influence the level of economic activity in the steady-state.[5]

Farmer (2012) shows that the steady-state level of economic activity depends on the confidence of investors about asset prices in the future, especially stock prices. However, asset price that matters is not just stock price. House prices also have profound effects on how individuals form their confidences on the future of the economy. House prices especially matter where people possess significant portion of their wealth in the form of housing equity. For an economy like South Korea, individuals own more than 70 percent of their wealth in the form of housing asset. In this case, the economic activity would be heavily influenced by the confidence of investors about house prices in the future. Thus, we can argue that house price is one of the main variables that the government or the central bank should control in order to stabilize the business fluctuations. However, little works have been done in academics to show that the authorities should seriously take asset prices such as house prices into account to maintain the macroeconomic stability.

Farmer (2012) concludes that the aggregate activity explicitly depends on the self-fulfilling beliefs about stock prices. My work differs from Farmer (2012) in the sense that it is not just self-fulfilling beliefs about stock prices but also self-fulfilling beliefs about house prices that independently influence the aggregate economic activity. This idea makes more sense with the economy like the Korean economy where most of households' wealth takes the form of real estate, i.e., houses. In order to incorporate the self-fulfilling expectations about house prices into the model as one of independent economic fundamentals, I modify the structure of capital goods into traded capital[6] and non-traded capital, which implies that the capital market is partially integrated with the world capital market. With this set-up, I am able to convert the closed economy model of

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[5] The idea that "animal spirits" or self-fulfilling beliefs can influence the business fluctuations in a dynamic general equilibrium model such as real business cycles model is proved by many works including Benabib and Farmer (1994) and Farrner and Guo (1994, 1995). Self-fulfilling beliefs in these models are empirically interpreted as forecast errors which are not related with any fundamental variables in the model. Self-fulfilling beliefs as forecast errors are able to influence the second moments of the macroeconomic variables, but unable to alter the steady state level of economic activity.

[6] Traded capital is an asset which is easily traded internationally. Stocks are the best example of traded capital. Meanwhile, non-traded capital such as house is much less internationally traded due to physical and legal constraints.

Farmer (2012) into the open economy model and also able to show that the business cycles of an open economy with partial capital mobility explicitly depend on the self-fulfilling beliefs of investors about the non-traded capital market, that is, housing market. The open economy model developed in this paper is able to show how the degree of openness is related with the likelihood of people having pessimistic (optimistic) self-fulfilling expectations about the non-traded capital prices and the likelihood of an economy falling into the depression (expansion). I argue that the economy is more likely to have inefficiently high unemployment and suffer from the recession because people are more likely to form pessimistic self-fulfilling expectations when the economy is more open to the world capital market. This implies that the government or the central bank needs to pay more attention to the non-traded asset prices (house prices) when the economy becomes more open.[7] As far as I know, no paper argues this point in the way that my work does using the micro-founded old-Keynesian model of two-sector open economy with traded and non-traded capital.

Research works on the relationship between confidences of investors and economic fluctuations are related with this paper. For instances, Chauvet and

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[7] One may raise the following question: "The 2008 crisis came from the breakdown of U.S. sub-prime mortgage market and it was not a crisis from non-traded capital sector. The 2008 crisis came from traded capital sector since steep deteriorations in the values of financial derivatives such as CDOs (Collateralized Debts Obligations) and CDS (Credit Default Swap) are at the center of the 2008 financial crisis and these derivatives are internationally traded. Therefore, the Great Recession was not related with non-traded capital." However, the breakdown of the U.S. sub-prime mortgage market was caused by the crash of housing prices beginning in early 2007. The sub-prime mortgage market works only when the housing price continues to rise. As long as the housing price keeps rising, households with sub-prime mortgage loan only have to make small mortgage payments for a short period of time, and eventually sell off houses at higher prices to pay off debts. Everyone in the market expected house prices to keep rising and the sub-prime mortgage market expanded. Financial derivatives based on the sub-prime mortgage loans such as CDOs and CDS were also issued and sold out on the premise that house prices would continue to rise. Once the house price stopped rising and the income growth began to stagnate, the defaults on the sub-prime mortgage loan rose and as a result, foreclosures increased. This caused people to expect further falls in house prices in the future, which made more people sell more houses. This process brought out pessimistic self-fulfilling expectations on house prices and eventually the sub-prime mortgage market collapsed. Enormous losses were generated to financial institutions all over the world that invested huge money in various derivatives based on the sub-prime mortgage-backed securities. Frozen capital market caused a severe economic slowdown. This is how world economy was hit by the 2008 global financial crisis originated from the U.S. sub-prime mortgage market. Thus, we can say that it was the depressed price of non-traded capital (houses) that triggered the 2008 global financial crisis and the following Great Recession.

Guo (2003) examine the behavior of non-fundamental shifts in agents' expectations around economic downturns by measuring shifts in expectations with consumer sentiment index and business formation index. Matsusaka and Sbordone (1995) also examine the link between consumer confidence and economic fluctuations using vector autoregressions. Harrison and Weder (2006) construct a proxy to measure non-fundamental changes in expectations using interest rate spread and then examine the extent to which self-fulfilling beliefs can explain the economic fluctuations during the Great Depression era. Non-fundamental changes in expectations in these papers are empirically equivalent to forecast errors which are not related with any disturbances to the fundamentals of the economy. Benabib and Farmer (1994) and Farmer and Guo (1994, 1995) show that non-fundamental changes in expectations, in other words, sunspot shocks influence only the volatilities of the detrended macroeconomic variables or the co-movements among them. The model in this paper differs from previous works in the sense that self-fulfilling beliefs are able to influence the steady-state level of macroeconomic variables, not just their second moments. Nakajima (2003) constructs a neoclassical growth model in which individuals receive utility directly from the value of their wealth and shows that fluctuations in asset prices including land prices, not just stock prices can generate co-movements among output, consumption, and investment. Nakajima (2003) is close to the model in this paper in the sense that it explicitly uses changes in asset prices to replicate the business cycles in Japan, but it still only accounts for the second moments of the business cycle facts, not the steady-state level of economic activity.

The rest of the paper is organized as follows. Section 2 shows what happened to asset prices and the economic activity represented by the unemployment rate during the Great Depression and the Great Recession in the U.S. It also shows what happened to asset prices and the economic activity in the Korean economy as an example of small open economy. I argue in section 2 that non-traded capital such as house also plays a critical role in business fluctuations. In Section 3 a branch of dynamic general equilibrium model based on the idea of *The General Theory* and labor search model is developed and shows that the confidence of investors about the house prices in the future independently determines the steady-state level of the unemployment rate and the level of economic activity. Concluding remarks are given in Section 4.

II. Asset Prices and the Unemployment Rate

The idea that the economic activity depends on asset prices is well supported by the data. For example, the behavior of asset prices and the unemployment rate during the Great Depression in the U.S. shows that collapse in asset prices had a devastating effect on the unemployment rate. Figure 1 clearly shows that stock prices are negatively correlated with the unemployment rate. Keynes interpreted this relationship as the evidence for a spontaneous fall in confidence of investors about the future which was responsible for the stock market crash and caused the Great Depression. Keynes argued that the stock prices fell because investors in the stock market believed that the machines and factories that produce profits would have much lower values in the future. This belief transmitted to other investors turned into a mass hysteria that affected all stock market participants simultaneously. Firms stopped purchasing new capital goods and the workers who produced capital goods lost their jobs. These unemployed workers reduced purchasing consumer goods, and workers who produced consumer goods also lost their jobs. This is how confidence of investors about stock prices in the future affects the unemployment, in other words, the level of economic activity.

Figure 1. U.S. Stock Price and the Unemployment Rate: Great Depression
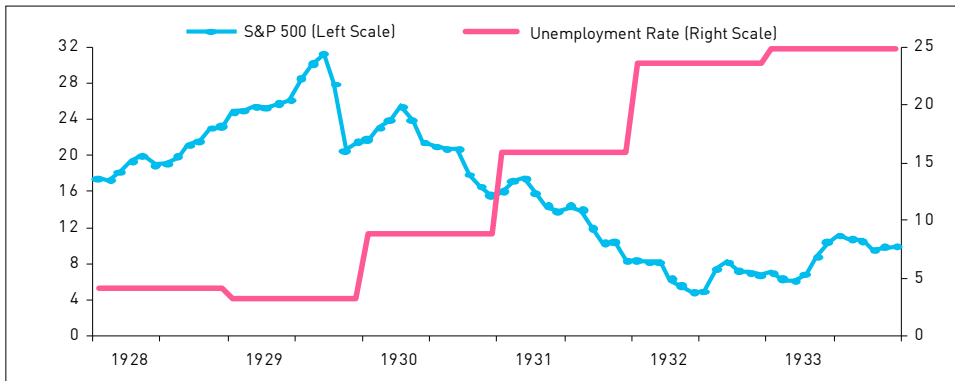
Source: The U.S. Bureau of Labor Statistics, S&P/Case-Shiller Home Price Indices.

However, they were not just stock prices that fell and caused the confidence of investors to deteriorate during the Great Depression. House prices also decreased significantly. Certainly the fall in house prices might have contributed

to even a bigger fall in confidence of investors because houses as well as stocks are one of major assets that individuals own. Figure 2 shows this.

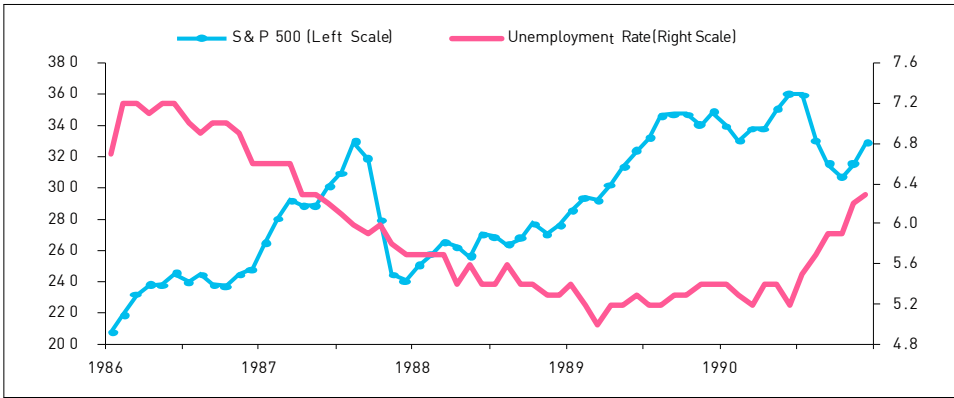Figure 2. U.S. Stock Price and House Price: Great Depression
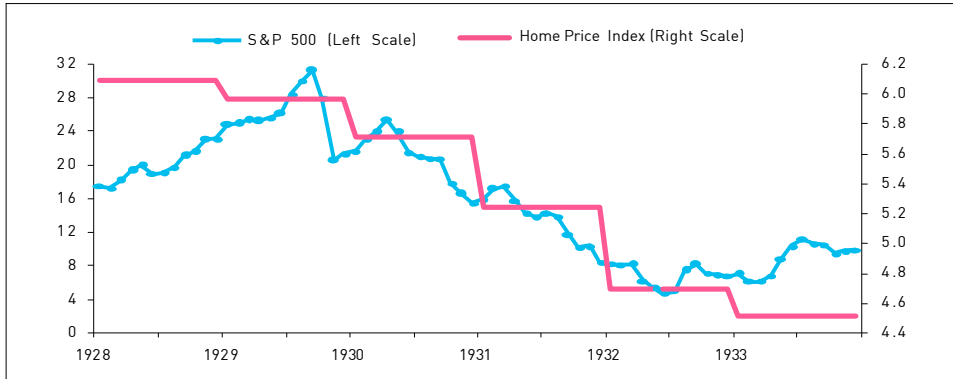
Source: S&P/Case-Shiller Home Price Indices.

The Great Depression started with the first Black Monday which was on October 28, 1929, when the stock market fell 13 percent. This is the second biggest decline of stock prices in the U.S. history. The worst fall was the second Black Monday that occurred on October 19, 1987. The S&P 500 dropped 21 percent from 283 to 225 in one day. The first Black Monday was the onset of the Great Depression, but the second one had much less impact on the economy. Figure 3 and 4 show why. Figure 3 shows that the unemployment rate continued to fall although the stock prices abruptly fell. This is in clear contrast with what happened during the Great Depression. Figure 4 shows that house prices were constantly increasing during the 1980s. The second Black Monday didn't turn into a deep recession because there were no serious deteriorations in the confidence of investors. People quickly recovered their confidences about their asset values in the future because house prices were increasing during the whole 1980s. The loss in stock market could be replaced by the increase in the value of housing equity. This prevented the second Black Monday from turning into the second Great Depression.[8]

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[8] In addition to rising house prices, the appropriate response of the Fed also helped people quickly recover their confidences on the future values of stocks. The Fed Chairman Alan Greenspan responded to the huge drop in the stock market by announcing publicly that the Fed stood ready to supply any necessary amount of cash to the banking sector including the retail banks, investment

Figure 3. U.S. Stock Price and the Unemployment Rate: The Second Black Monday

Source: The U.S. Bureau of Labor Statistics, S&P/Case-Shiller Home Price Indices.

Figure 4. U.S. Stock Price and House Price: The Second Black Monday
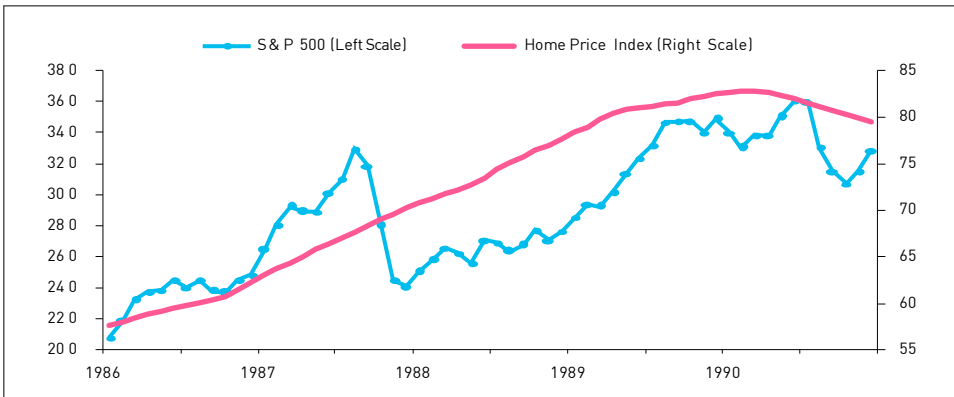
Source: S&P/Case-Shiller Home Price Indices.

Figure 5 shows that stock prices declined steeply again when the U.S. economy entered into a recession in 2001 caused by the collapse of IT bubble in 2000. The unemployment rate increased, but it was mild. It rose from 4.0 percent in 2000 to 6.0 percent in 2003 on average. And it started falling down from the second half of 2003 until 2008 when the global financial crisis broke

banks and the brokerage houses. However, I believe that people recovered confidence quickly and continued spending mainly because house prices were steadily rising and, as a consequence, people expected their asset values in the future to be robust.

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out. The 2001 recession was close to what happened in the second Black Monday in 1987 because house prices were constantly rising during the 1990s and 2000s until the crisis broke out. (See Figure 6) The loss in stock market wealth caused by the 2000 collapse of IT bubble was replaced by rising housing equity. Households lost money in the stock market, but gained from the housing boom in the 1990s and 2000s before the 2008 crisis. Thanks to the housing boom, investors recovered confidence in asset markets in a short period of time, which made it possible for the stock prices to rise again and for the unemployment to keep falling until the economy was hit by the 2008 crash.

The 2008 crash is more like what happened in the 1930s because both stock prices and house prices fell dramatically. Confidence of investors was heavily impaired because people lost their wealth in housing market as well as in stock market. As a consequence of self-fulfilling process of falling asset prices, firms and households dramatically reduced spending, and this led to a huge fall in aggregate demand. Unemployment soared from 4.4 percent in 2007 to 10.0 percent in 2009 and still stayed above 8 percent in 2012.

We can raise a question about the causation between asset prices and the economic activity. For instance, did the low-frequency change in asset price cause the change in the unemployment rate, or did causation run in the opposite direction? Classical economics implies that the low-frequency changes in the unemployment rate should be explained by low-frequency changes in the natural rate of unemployment which are caused by changes in the fundamentals of the economy. In contrast, the economics of Keynes implies that low-frequency changes in the unemployment rate are potentially explained by low-frequency changes in aggregate demand. Aggregate demand, in turn, depends on the confidence of investors about the asset prices in the future. Thus, as long as investors do not update their confidence about the future, aggregate demand is stuck at some level. As a consequence, so is the unemployment rate. Following Keynes (1936), I argue that this is much easier way of justifying the low-frequency co-movements between asset prices and the unemployment rate rather than justifying it with low-frequency changes in the fundamentals of the economy.

Figure 5. U.S. Stock Price and the Unemployment Rate (1998~2012)
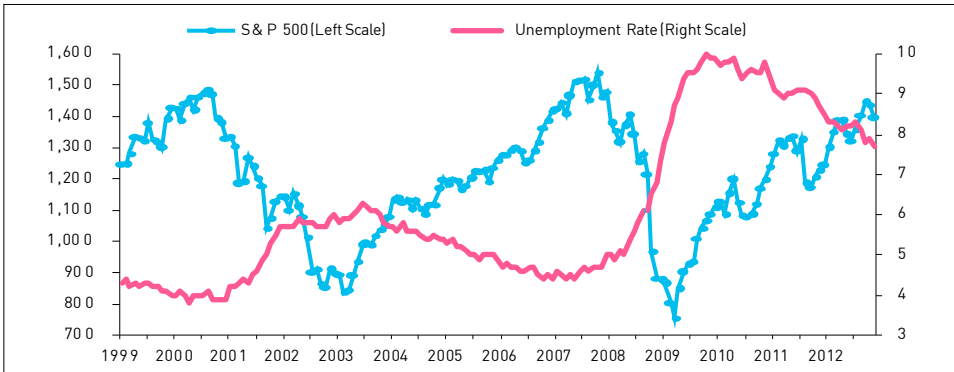
Source: The U.S. Bureau of Labor Statistics, S&P/Case-Shiller Home Price Indices

Figure 6. U.S. Stock Price and House Price (1998~2012)
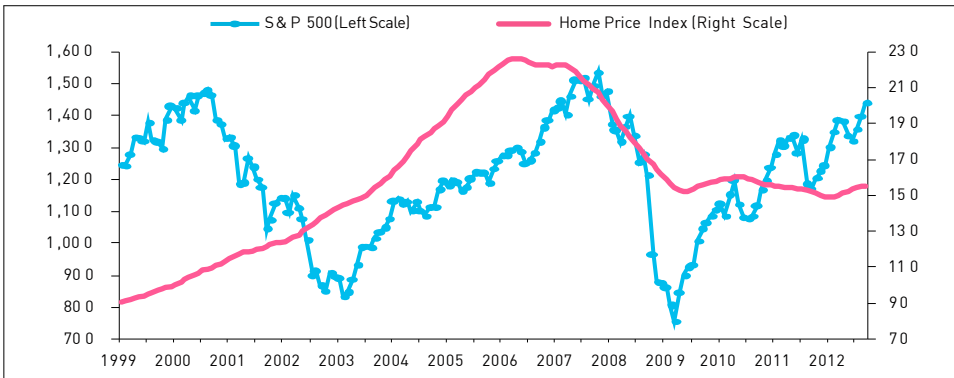

Source: S&P/Case-Shiller Home Price Indices.

Figure 7 and 8 show that house prices as well as stock prices are also strongly correlated with the unemployment rate in Korea. I take Korean data as an example for a small open economy. Except for the period of 1997-98 Asian financial crisis, house prices seem to show stronger co-movements with the unemployment rate at the lower frequencies. Simple correlation coefficient between house prices and the unemployment rate is -0.68, while it is -0.49 between stock prices and the unemployment rate over the sample period. I interpret this as an evidence for stock prices and house prices both being able to affect the unemployment rate, but house prices being more influential.

Figure 7. House Price and the Unemployment Rate in Korea
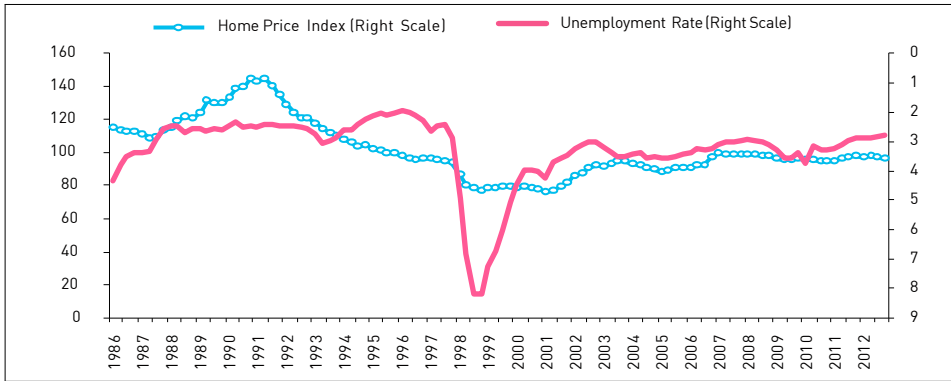
Source: Bank of Korea, National Statistical Office

Figure 8. Stock Price and the Unemployment Rate in Korea
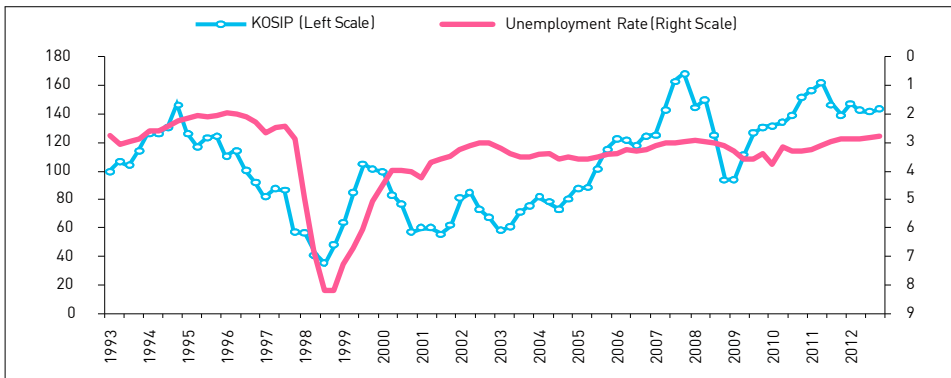
Source: Bank of Korea, National Statistical Office

   The fact that the Korean economy is influenced by house prices in the
longer-run more than by stock prices is also validated by Figure 9. Figure 9
shows us the relative size of housing assets out of total assets owned by the
Korean households. The Korean households held 71 percent of their assets in
the form of housing assets on average between 1997 and 2011. Due to the
large portion of housing assets out of total household assets, loss in confidence
of households about house prices would have much bigger effects on the Korean
economy than loss in confidence of investors about stock prices would have.

Figure 9. Relative Size of Housing Asset owned by the Korean Households
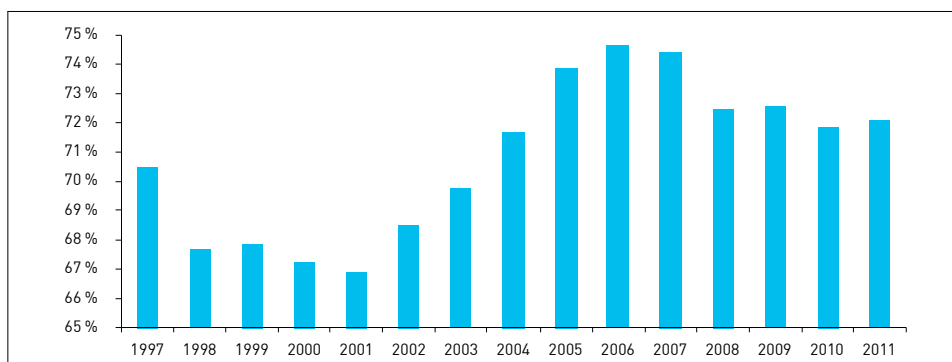
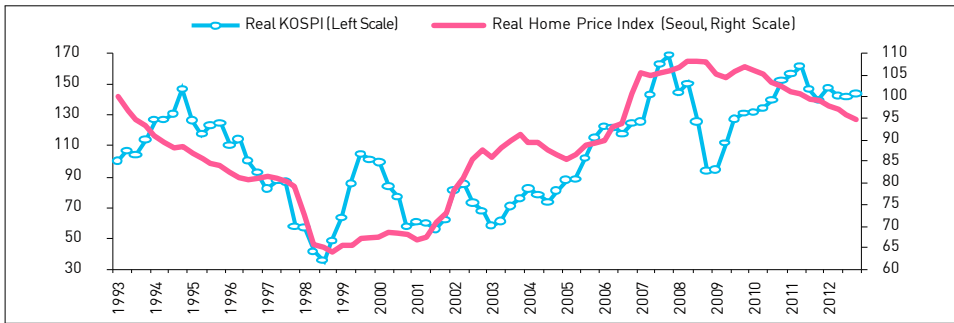Source: Bank of Korea, National Statistical Office

Figure 10 shows us what happened to the stock prices and house prices in Korea.[9] Even prior to the Asian financial crisis, both stock prices and house prices in real terms had been falling simultaneously. After touching the trough, stock prices and house prices started rising again. Once recovered from the abrupt falls in 2000 due to the collapse of IT bubble, stock prices continued to rise until the 2008 global financial crisis broke out. Robust increases in stock prices certainly strengthened the confidence of investors about the stock market. House prices also rose simultaneously, which significantly improved the confidence of households who held more than 70 percent of their assets in the form of real estates. Without a doubt, steep rises of house prices further strengthened the confidence of investors about house prices in the future. Big wealth effects from rising asset prices occurred and supported the robust growth of the Korean economy. Improved confidence made households spend more to purchase houses, which led to even higher increases in house prices. This self-fulfilling process of rising house prices continued until the economy was hit by the crash in 2008. This is why the Korean economy has suffered much from the economic recession since 2008. Although stock prices considerably recovered from the 2008 crash, house prices are still depressed. House prices continued to fall since the 2008 crash, which means that confidence of investors about the housing market was critically weakened and stayed low since. Weak confidence of investors resulted in negative wealth effects. Firms and households

[9] Figure 10 shows house prices in the metropolitan Seoul area. In Korea, house prices in the metropolitan Seoul area are known to play a barometer reflecting how investors perceive the housing market.

stopped spending on new capital goods and new houses, which led to a huge
fall in aggregate demand.

Overall, Figure 10 shows the positive correlation between stock prices and
house prices in Korea, which weakens the necessity of treating house prices
separately from stock prices. But if we focus on recent years, we can verify
a clear negative correlation between stock prices and house prices especially
since the 2008 crisis. Figure 11 shows this. The correlation coefficient between
stock prices and housing prices is -0.47. Thus, I argue that housing prices are
more correlated with the real economy since the 2008 crisis than they were
before the crisis. The model in this paper aims to explain the business cycles
of major economic upheaval such as the Great Depression or Great Recession
since the 2008 global financial crisis. Therefore, it is empirically relevant for
the model to treat on house prices separately from stock prices that influenced
the Korean economy since the 2008 global financial crisis.

Figure 10. Stock Price and House Price in Korea

Source: Bank of Korea, National Statistical Office

Figure 11. Stock Price and House Price in Korea since the 2008 Crash
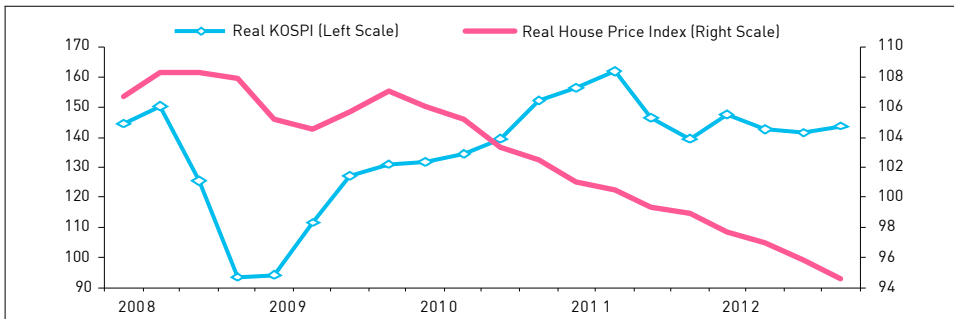
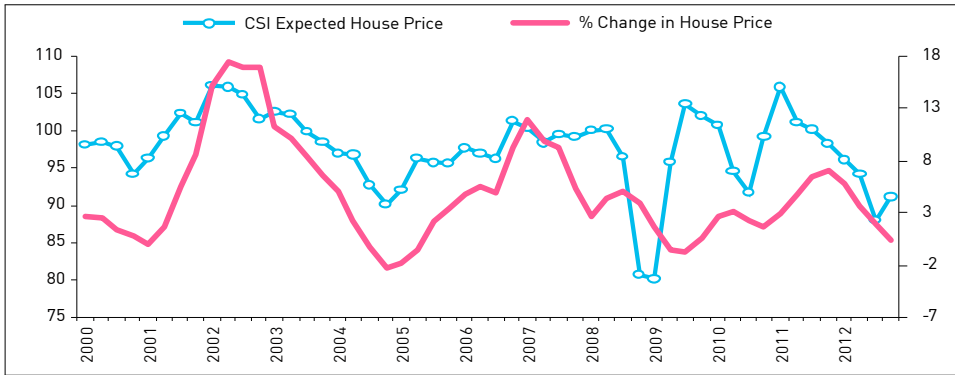Source: Bank of Korea, National Statistical Office

Evidences presented in this section show that what really matters in determining the unemployment rate or the level of economic activity is the confidence of investors about the value of assets in the future. The economy would shift from a steady state with low (high) unemployment rate to a steady state with high (low) unemployment if investors lose (gain) confidence in asset markets. This implies that a particular confidence level can select a particular steady state with a particular rate of unemployment out of infinite numbers of steady states in the economy. In terms of dynamic stochastic general equilibrium theory, we can say that there is a continuum of labor market equilibria and confidence about the future value of the asset markets selects an equilibrium. Confidence of investors must be taken as an independent fundamental of the economy. Most of theoretical models that deal with equilibrium indeterminacy are not comfortable in integrating confidence of investors into the dynamic model. For a typical example, Farmer and Guo (1994, 1995) introduce confidence of investors into the dynamic system as forecast errors. This is why changes in confidence, in other words, sunspot shocks alter only the second moments of macroeconomic variables such as volatilities or co-movements. In this case, confidence as a forecast error is unable to select a specific steady state as an equilibrium. On the other hand, confidence of investors is incorporated into the model by an asset price as an independent variable in Farmer (2012). Aggregate macroeconomic variable such as employment explicitly depends on asset prices. In this case, specific level of confidence of investors about asset prices can select a specific equilibrium out of a continuum of market equilibria. One more thing to note is that it is not only stock market that influences confidence of investors, but housing market also significantly affects how investors perceive the future prospects of asset values.

In this section I try to show that confidence of investors influence the real economy by reviewing the long-run trends of stock prices, house prices and real economic variable such as the unemployment rate. This notion can be verified further by looking into a variable more directly related with the public's expectations. Figure 12 shows the correlation between CSI (consumer survey index) on expected house prices and percent changes in house prices, while Figure 13 shows the correlation between CSI on expected stock prices and percent changes in house prices. Correlation coefficient between CSI on expected stock prices and percent changes in housing prices is 0.28, while correlation coefficient between CSI on expected housing prices and percent changes in housing prices is 0.53. This implies that people's expectations on house prices

certainly influence actual changes in house prices. When people expect that house prices increase in the future, then the demand for houses rises. As a result, house prices start rising. That is, expectation influences the realized outcome. This is why we have positive correlation between CSI on expected house prices and percent change in house prices. This correlation is twice as strong as the correlation with CSI on expected stock prices.[10] Section 3 now develops a small open economy model that supports the notion that expectation alters the realized outcome.

Figure 12. Expected House Price and Changes in House Price

Source: Bank of Korea, National Statistical Office

Figure 13. Expected Stock Price and Changes in House Price
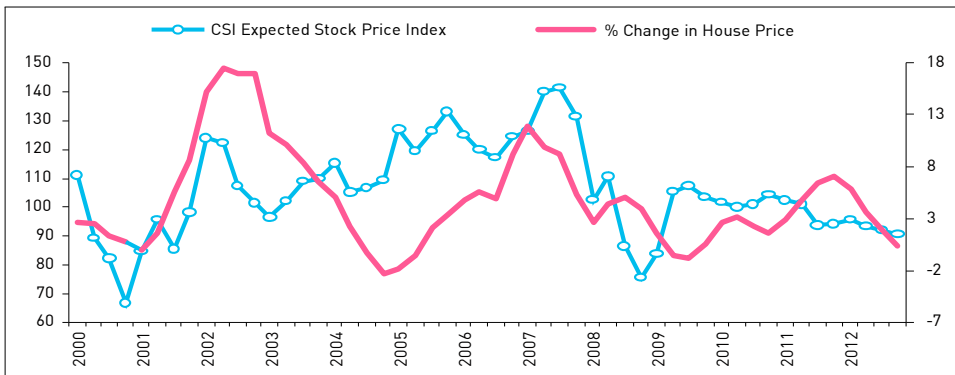
Source: Bank of Korea, National Statistical Office

[10] This can be interpreted as another evidence that it is appropriate to treat house price as a separate variable from stock price

III. The Model

1. The Basic Structure of the Model

In this section, I develop a small open economy model in which the level of economic activity explicitly depends on the expectations about the price of non-traded capital such as houses. Following Barro et al. (1995), the economy has two types of capital: traded capital (K_t^T) and non-traded capital (K_t^N) in fixed supply.[11] There is a unit measure of identical representative families who live infinitely. There are n consumption goods and $K_t = 1$ units of capital. Following Farmer (2010b, 2012), each family is assumed to have a measure 1 of workers, all of whom begin the period unemployed. H_t represents the measure of household members that search for jobs. H_t is no greater than 1. The measure of household members that find jobs is $\tilde{q}_t H_t$, where $\tilde{q}_t$ is the probability that a searching worker find a job and is taken as given by the household in a search market equilibrium. Preferences of households are described by the following logarithmic utility function:

$$J_t = \sum_{s=t}^{\infty} \left[\beta^{s-t} \sum_{i=1}^{n} g_i log(C_{i,s}) \right] \tag{1}$$

where $\sum_{i=1}^{n} g_i = 1$ and the g_i are preference weights. The household faces the following sequence of constraints.

$$B_{t+1} + p_{k,t}^T K_{t+1}^T + p_{k,t}^N K_{t+1}^N = (p_{k,t}^T + rr_t^T)K_t^T + (p_{k,t}^N + rr_t^N)K_t^N$$
$$+ (1+r^w)B_t + w_t L_t - \sum_{i=1}^{n} p_{i,t} C_{i,t} \tag{2}$$

$$L_t = \tilde{q}_t H_t \tag{3}$$

$$U_t = H_t - L_t \tag{4}$$

$$lim_{S \to \infty} Q_t^S K_{t+1} \geq 0 \quad \text{where} \quad K_{t+1} = K_{t+1}^T + K_{t+1}^N \tag{5}$$

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[11] The simplification of non-reproducible capital makes the model simpler and enables us to draw out the relationship between the value of asset market and the level of economic activity more easily. Positive investment in capital would add more dynamics onto the model, but the basic implications would differ little.

L_t is the measure of workers who find a job and U_t is the measure of unemployed workers. w_t is the money wage, $p_{i,t}$ is the money price of good i, and $C_{i,t}$ is consumption of good i. K_t is owned by the household. rr_t^T is the rental price of traded capital, rr_t^N is the rental price of non-traded capital, $p_{k,t}^T$ is the money price of a traded capital, and $p_{k,t}^N$ is the money price of non-traded capital. Households can accumulate net foreign bonds (B_t).[12] r^w is the world interest rate. Equation (5) is the no-Ponzi scheme constraint where Q_t^s is defines as the following.

$$Q_t^s = \Pi_{k=t}^{s-1} \frac{1}{(1+i_k)}, \ s > t \text{ and } Q_t^t = 1. \tag{6}$$

Riskless borrowing and lending at money rate of interest rate i_t is assumed in the financial market. Then, no-arbitrage condition implies that

$$1 + i_t = \frac{p_{k,t+1} + rr_{t+1}}{p_{k,t}} \tag{7}$$

where i_t is the money rate of interest between dates t and $t+1$. In this model the household has no disutility from work. Thus, it sends all of its members into the labor market to search for a job. In the beginning of each period, all members are hired and then fired at the end of each period. In the next period, the entire labor force is rehired. Complete turnover in the labor market is an extreme assumption, but it makes the solution simple.

In this economy the production process consists of two stages. First, intermediate products are produced and used as inputs for the production of final outputs. There are two types of intermediate products. One is produced using traded capital. This is denoted by $m_{i,t}^T$ which is the intermediate goods to be used to produce ith final commodity. The other is produced using non-traded capital. This is denoted by $m_{i,t}^N$. No labor input is employed in the production of intermediate goods. The production functions of intermediate goods are given by the following Cobb-Douglas function.

$$m_{i,t}^T = A(K_{i,t}^T)^\alpha \text{ and } m_{i,t}^N = A(K_{i,t}^N)^\alpha \tag{8}$$

[12] There will be no borrowing and lending in equilibrium because all households are identical.

where α is the capital share and A is the exogenous productivity parameter. Both parameters are assumed to be the same in the production of the two intermediate goods in order to simplify the analysis. Final output of the ith commodity is denoted by $Y_{i,t}$, and is also produced by a Cobb-Douglas function,

$$Y_{i,t} = K_{i,t}^{a_i} X_{i,t}^{b_i} \tag{9}$$

where $a_i + b_i = 1$ and $K_{i,t} = (m_{i,t}^T)^\theta (m_{i,t}^N)^{1-\theta}$. θ can be interpreted as the degree of openness because it stands for the relative size of the traded capital sector. $K_{i,t}$ is the rental demand for capital by firm i, and $X_{i,t}$ is the firm i's allocation of labor to production. We can rewrite (9) as the following.

$$Y_{i,t} = A^{a_i} (K_{i,t}^T)^{\alpha\theta a_i} (K_{i,t}^N)^{\alpha(1-\theta)a_i} X_{i,t}^{b_i} \tag{10}$$

The, the profit for the firm producing ith commodity is given by the following.

$$\pi_{i,t} = p_{i,t} A^{a_i} (K_{i,t}^T)^{\alpha\theta a_i} (K_{i,t}^N)^{\alpha(1-\theta)a_i} X_{i,t}^{b_i} - w_t L_{i,t} - rr_t^T K_{i,t}^T - rr_t^N K_{i,t}^N \tag{11}$$

Firms maximize profits taking $p_{i,t}$, w_t, rr_t^T, rr_t^N and q_t as given. Each firm solves the following problem.

$$\max_{\{K_{i,t}^T, K_{i,t}^N, X_{i,t}, L_{i,t}\}} \quad \begin{aligned} & p_{i,t} A^{a_i} (K_{i,t}^T)^{\alpha\theta a_i} (K_{i,t}^N)^{\alpha(1-\theta)a_i} X_{i,t}^{b_i} - w_t L_{i,t} \\ & - rr_t^T K_{i,t}^T - rr_t^N K_{i,t}^N \end{aligned} \tag{12}$$

such that

$$L_{i,t} = X_{i,t} + V_{i,t} \tag{13}$$

$$L_{i,t} = q_t V_{i,t} \tag{14}$$

where $L_{i,t}$ is total labor hired by firm i, $V_{i,t}$ is the labor that firm i allocates to recruiting and $X_{i,t}$ is the labor that firm i allocates to production. We interpret q_t as the private recruiting efficiency parameter. $X_{i,t}$ can be rewritten in terms of $L_{i,t}$ by combining equation (13) and equation (14).

$$X_{i,t} = \varnothing_t\, L_{i,t} \tag{15}$$

where $\varnothing_t = (1 - \dfrac{1}{q_t})$ and $\varnothing_t$ is interpreted as the social recruiting efficiency parameter. $\varnothing_t$ reflects the externality arising in the labor search market.[13] Using (15), we can derive the reduced form expression for profits as the following.

$$\pi_{i,t} = p_{i,t}\, A^{a_i}\, \varnothing_t^{b_i}\, (K_{i,t}^T)^{\alpha\theta a_i}\, (K_{i,t}^N)^{\alpha(1-\theta)a_i}\, L_{i,t}^{b_i} - w_t\, L_{i,t} - rr_t^T\, K_{i,t}^T - rr_t^N\, K_{i,t}^N \tag{16}$$

Firm's profit maximization equates the marginal products to the rental rate. Thus, we have the following first-order conditions.

$$\alpha\theta a_i p_{i,t}\, Y_{i,t} = rr_t^T\, K_{i,t}^T \tag{17}$$

$$\alpha(1-\theta)a_i p_{i,t}\, Y_{i,t} = rr_t^N\, K_{i,t}^N \tag{18}$$

$$b_i p_{i,t}\, Y_{i,t} = w_t\, L_{i,t} \tag{19}$$

2. The Closed Economy Case

When the economy is closed, there is no international borrowing or lending. Budget constraint (2) is rewritten as the following.

$$p_{k,t}^T\, K_{t+1}^T + p_{k,t}^N\, K_{t+1}^N = (p_{k,t}^T + rr_t^T)K_t^T + (p_{k,t}^N + rr_t^N)K_t^N + w_t\, L_t - \sum_{i=1}^{n} p_{i,t}\, C_{i,t} \tag{20}$$

Households maximize (1) with constraints (20), (3), (4), and (5).[14] Euler equation and a set of intertemporal first order conditions for the household's utility maximization problem imply the following.

---

[13] No price signals exist in the labor market to assess the value of search inputs such as time spent by workers searching for jobs and time spent by recruiters in the recruiting department of a firm searching for workers. Due to this special feature of search inputs, the externality arises in the search process and it influences the hiring and production decisions by firms. See chapter 7 in Farmer (2010a) for more intuitive details about search inputs.

[14] When the households solve their problems, H_t is set equal to 1 because every family member participates in the labor force looking for job since no utility from leisure is assumed in the model.

$$\frac{1}{C_t} = \frac{\beta}{C_{t+1}}(1 + i_t)$$ (21)

where C_t is consumption expenditure and defined as $C_t = \sum_{i=1}^{n} p_{i,t} C_{i,t}$. If we iterate budget constraint (20) forward, then we can derive the following expression.

$$\sum_{s=t}^{\infty} Q_t^s C_s = (p_{k,t}^T + rr_t^T)K_t^T + (p_{k,t}^N + rr_t^N)K_t^N + h_t$$ (22)

where $h_t = \sum_{s=t}^{\infty} Q_t^s w_s L_s$. h_t is the net present value of labor income and defined as human wealth of the family. Total wealth, W_t, is the sum of financial wealth and human wealth.

$$W_t = (p_{k,t}^T + rr_t^T)K_t^T + (p_{k,t}^N + rr_t^N)K_t^N + h_t.$$ (23)

Equations (21), (22) and (23) put together produce the solution to the household problem. The solution is to spend a fixed fraction of total wealth on consumption goods as the following.

$$C_t = (1 - \beta) W_t$$ (24)

Rental prices of two kinds of capital are equalized in the equilibrium of the closed economy. That is, $rr_t^T = rr_t^N (= rr_t)$. Using this equality, (17) and (18) imply that $K_{i,t}^T = \theta K_{i,t}$ and $K_{i,t}^N = (1 - \theta)K_{i,t}$. Using these relationships, the reduced form of production function in the closed economy is derived in terms of $K_{i,t}$ and $L_{i,t}$.

$$Y_{i,t} = \theta_c^i A^{a_i} \varnothing_t^{b_i} K_{i,t}^{\alpha a_i} L_{i,t}^{b_i}$$ (25)

where $\theta_c^i = \{\theta^\theta (1 - \theta)^{1-\theta}\}^{\alpha a_i}$. Firm's profit maximization using (25) leads us to the following conventional first-order conditions.

$$\alpha a_i p_{i,t} Y_{i,t} = rr_t K_{i,t}$$ (26)

$$b_i p_{i,t} Y_{i,t} = w_t L_{i,t}$$ (27)

1) Deriving the Aggregate Supply Equation

Following the notation of Keynes (1936), let the variable Z_t denote nominal GDP. That is, $Z_t \equiv \sum_{i=1}^{n} p_{i,t} Y_{i,t}$. In this simple closed economy, there is no investment and no government expenditure, which implies that $Z_t = C_t$. It is obvious that consumer allocates a fraction g_i of total consumption expenditure to good i because preference is assumed to be logarithmic. Thus,

$$p_{i,t} C_{i,t} = g_i C_t \tag{28}$$

Market clearing condition for ith commodity market implies that $C_{i,t} = Y_{i,t}$. Thus, we have

$$p_{i,t} Y_{i,t} = g_i C_t \tag{29}$$

We derive equation (30) from (29) since $Z_t = C_t$.

$$p_{i,t} Y_{i,t} = g_i Z_t \tag{30}$$

If we substitute equation (30) into (27), the following expression is derived.

$$b_i g_i Z_t = w_t L_{i,t} \tag{31}$$

Summing equation (31) over all industries leads us to the following equation which describes the relationship between aggregate supply and the level of employment.

$$Z_t = \frac{1}{\chi} L_t \tag{32}$$

where $\chi \equiv \sum_{i=1}^{n} b_i g_i$.[15] If we substitute equation (30) into (26) and sum over all industries, then we have the following expression for capital.

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[15] Following Keynes (1936), aggregate variables are measured by "wage units". Thus, the date t numeraire is chosen to be labor by setting $w_t = 1 (t = 1,...,\infty)$. Note that $Z_t \leq \frac{1}{\chi}$ since $L_t \leq 1$.

$$a\psi Z_t = rr_t K_t \tag{33}$$

where $\psi \equiv \Sigma_{i=1}^n a_i g_i$.

2) Deriving the Aggregate Demand Equation

The consumption Euler equation (21) combined with equation (7), (33) and aggregate market clearing condition ($Z_t = C_t$.) is expressed as the following.

$$\frac{1}{Z_t} = \frac{\beta}{Z_{t+1}}\left(\frac{p_{k,t+1}}{p_{k,t}}\right) + \frac{\beta\psi}{p_{k,t}} \tag{34}$$

Forward iteration of equation (34) brings us the equation describing the relationship between aggregate demand and asset prices.

$$Z_t = \left(\frac{1-\beta}{\beta\psi}\right)p_{k,t} \tag{35}$$

Equations (32) and (35) are two major building blocks for the model in this paper.[16] We now define the set of feasible expectations using (32) and (35) as the following.

Definition of Long-Term Expectations: The economy has a bounded state of (long-term) expectations which is defined by a non-negative sequence $\{p_{k,s}\}_{s=t}^{\infty}$ such that $p_{k,s} < \dfrac{\psi\beta}{\chi(1-\beta)}$.[17]

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[16] In equation (35), the price of asset explicitly shows up as an independent variable that influences the aggregate demand, which is consistent with Keynes's idea of animal spirits as an independent and fundamental variable that drives the business cycles. This reveals the fundamental difference between the current model and other literature that deals with self-fulfilling beliefs and sunspots. In most of existing literature, for instance, in Farmer and Guo (1994), changes in self-fulfilling beliefs are represented by forecast errors on some endogenous variables in the system. They are empirically nothing but random numbers. In the current model, changes in the belief about asset prices are no more just forecast errors. They are independent and fundamental driving forces for the fluctuations in the system.

[17] The maximum value of L_t is one. This implies that Z_t is bounded by χ^{-1} from equation (32). Thus, equation (35) implies that $p_{k,t}$ is bounded by $\dfrac{\psi\beta}{\chi(1-\beta)}$ for all t.

Keynes (1936) argued that the level of economic activity (or the level of employment) is selected by the state of long-term expectations.[18] Long-term expectations in this model are defined by a sequence of capital prices $\{p_{k,s}\}_{s=t}^{\infty}$ given above. No fundamentals in the model are associated with $\{p_{k,s}\}_{s=t}^{\infty}$, which means that $\{p_{k,s}\}_{s=t}^{\infty}$ is interpreted as a self-fulfilling sequence of values for the capital good. Changes in beliefs about the value of capital influence household wealth, which in turn alters consumption expenditure.

Equations (26), (30) and (33) determine the allocation of capital inputs across industries as the following.

$$K_{i,t} = \frac{a_i g_i}{\psi} \qquad (36)$$

Equations (31) and (35) determine the allocation of labor inputs across industries as the following.

$$L_{i,t} = \frac{(1-\beta)b_i g_i}{\beta\psi} p_{k,t} \qquad (37)$$

Summing equation (37) over all industries brings us the aggregate employment in Keynesian equilibrium that depends on the value of capital good. That is,

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[18] Regarding the state of long-term expectations, Keynes (1936) argues as the following:

These expectations, upon which business decisions depend, fall into two groups, certain individuals or firms being specialized in the business of framing the first type of expectation and others in the business of framing the second. The first type is concerned with the price which a manufacturer can expect to get for his "finished" output at the time when he commits himself to starting the process which will produce it···The second type is concerned with what the entrepreneur can hope to earn in the shape of future returns if he purchases (or, perhaps, manufactures) "finished" output as an addition to his capital equipment. We may call the former *short-term expectation* and the latter *long-term expectation*.

···these short-term expectations will largely depend on the long-term (or medium-term) expectations of other parties. It is upon these various expectations that the amount of employment which the firms offer will depend.

···the steady level of employment thus attained may be called the long-period employment corresponding to that state of expectation. It follows that, although expectation may change so frequently that the actual level of employment never had time to reach the long-period employment corresponding to the existing state of expectation, nevertheless every state of expectation has its definite corresponding level of long-period employment. (Keynes, 1936, Chapter 5)

$$L_t = \left\{ \frac{(1-\beta)\chi}{\psi\beta} \right\} p_{k,t} \tag{38}$$

3) Search and the Labor Market

Individual firm hires labor with private recruiting technology which is described by equation (15) taking q_t as given. Social recruiting efficiency parameter $\varnothing_t$ is endogenously determined by the aggregate economic activity. To see how this woks, let's assume that there is an aggregate match technology that is associated with aggregate employment as the following.

$$L_t = H_t^\eta (\Gamma V_t)^{1-\eta} = (\Gamma V_t)^{1-\eta} \tag{39}$$

Equation (39) means that L_t is the measure of workers who find jobs when a measure 1 of unemployed workers ($H_t = 1$) search and V_t workers are allocated to recruiting in aggregate by all firms. Jobs are assumed to be allocated to the ith firm in proportion to the fraction of aggregate recruiters attached to firm i.

$$L_{i,t} = \left(\frac{V_{i,t}}{V_t} \right) L_t \tag{40}$$

If we put equations (14), (39) and (40) together, we can express $X_{i,t}$ as the following.[19]

$$X_{i,t} = L_{i,t} \left(1 - \frac{L_t}{\Gamma} \right) \tag{41}$$

From equations (16) and (41), we can see that $\varnothing_t = 1 - \dfrac{L_t}{\Gamma}$ and $q_t = \dfrac{\Gamma}{L_t}$. When the economy is in recession (recovery), the unemployment rises (falls). Then, it gets easier (harder) for firm to hire workers, which means that private recruiting efficiency q_t rises (falls) in recession (recovery).

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[19] η is set equal to $\dfrac{1}{2}$ for the sake of simplicity.

4) The Solution to the Social Planning Problem

Equations (36), (37) and (38) define the allocations of factor inputs across industries and the aggregate employment in Keynesian equilibrium which mimics the decisions of a social planner. The economy has a continuum of Keynesian equilibria indexed by $p_{k,t}$. However, Keynesian equilibrium fails to maintain full employment allocations of resources that would be chosen by a social planner. This subsection discusses this. Social planner's problem in the closed economy case is defined as the following.

$$\max_{\{C_{i,s},X_{i,s},V_{i,s},L_{i,s},L_s,V_s\}} J_t = \sum_{s=t}^{\infty} \left[\beta^{s-t} \sum_{i=1}^{n} g_i log(C_{i,s}) \right] \tag{42}$$

such that

$$C_{i,s} \le A^{a_i} (K_{i,s}^T)^{\alpha\theta a_i} (K_{i,s}^N)^{\alpha(1-\theta)a_i} X_{i,s}^{b_i} \qquad (i=1,...,n) \tag{43}$$

$$L_{i,s} = X_{i,s} + V_{i,s} \qquad (s=t,...,\infty) \tag{44}$$

$$\sum_{i=1}^{n} L_{i,s} = L_s \qquad (s=t,...,\infty) \tag{45}$$

$$\sum_{i=1}^{n} K_{i,s}^T = \theta, \ \sum_{i=1}^{n} K_{i,s}^N = 1-\theta \qquad (s=t,...,\infty) \tag{46}$$

$$\sum_{i=1}^{n} V_{i,s} = V_s \qquad (s=t,...,\infty) \tag{47}$$

$$L_s = (\Gamma V_s)^{1-\eta} \qquad (s=t,...,\infty) \tag{48}$$

$$L_{i,s} = \left(\frac{V_{i,s}}{V_S} \right) L_s \qquad (s=t,...,\infty) \tag{49}$$

Taking the externality effect arising in the search process into account, the social planning problem can be simplified by the fact that $K_{i,t}^T = \theta K_{i,t}$ and $K_{i,t}^N = (1-\theta)K_{i,t}$ as follows.

$$\max_{\{C_{i,s}, L_{i,s}, L_s\}} J_t = \sum_{s=t}^{\infty} \left[\beta^{s-t} \sum_{i=1}^{n} g_i \log(C_{i,s}) \right] \tag{50}$$

such that

$$C_{i,s} \le \theta_c^i A^{a_i} (K_{i,s})^{\alpha a_i} \left(L_{i,s} \left(1 - \frac{L_s}{\Gamma} \right) \right)^{b_i} \qquad (i = 1,...,n) \tag{51}$$

$$\sum_{i=1}^{n} L_{i,s} = L_s \qquad (s = t,...,\infty) \tag{52}$$

$$\sum_{i=1}^{n} K_{i,s} = 1 \qquad (s = t,...,\infty) \tag{53}$$

Some tedious algebra produces the solution to the social planning problem defined by (50)~(53). Aggregate employment determined by the social planner is given by the following expression.

$$L_s = \frac{\Gamma}{2}, \qquad (s = t,...,\infty) \tag{54}$$

The allocations of labor and capital inputs across industries chosen by the social planner are given by the following equations.

$$L_{i,s} = \frac{b_i g_i}{\chi} L_s, \qquad (s = t,...,\infty) \tag{55}$$

$$K_{i,s} = \frac{a_i g_i}{\psi} \left(K_{i,s}^T = \frac{\theta a_i g_i}{\psi}, K_{i,s}^N = \frac{(1-\theta)a_i g_i}{\psi} \right) (s = t,...,\infty) \tag{56}$$

If we compare equation (38) with (54), we can see that aggregate employment in Keynesian equilibrium is hardly equal to the one chosen by the social planner. Aggregate employment in Keynesian equilibrium is equal to the socially optimal level only when the price of capital good is equal to a special value, p_k^*, which is derived as follows.

$$p_k^* = \frac{\psi \beta \Gamma}{2(1-\beta)\chi} \tag{57}$$

If the price of capital good, in other words, the stock market price $p_{k,t}$ is less than p_k^*, the unemployment rate would be inefficiently high and the economic activity is inefficiently depressed. If $p_{k,t} > p_k^*$, the unemployment rate is too low and the economic activity is overheated. Therefore, depending on the expectations about the stock market price, $p_{k,t}$, the economy may experience a recession or an expansion. Next section discusses the open economy case and derives some policy implications about monetary policy.

3. The Open Economy Case

In this section households are able to borrow or lend at the world interest rate, r^w. The economy is small enough relative to the rest of the world, and takes the world interest rate as given. Households offer or take only traded capital as collateral when they borrow or lend. Thus, the amount of debt households can have at date t can not exceed the value of K_t^T, which means that the economy is constrained by partial capital mobility. Partial capital mobility constraint is written as $B_{t+1} = -p_{k,t}^T K_{t+1}^T$.[20] Partial capital mobility also implies that no-arbitrage condition is given as the following.[21]

$$1 + r^w = \frac{p_{k,t+1}^T + rr_{t+1}^T}{p_{k,t}^T} \tag{58}$$

The partial capital mobility constraint and no-arbitrage condition (58) simplify the budget constraint (2) in a small open economy as the following.[22]

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[20] As long as the quantity of capital stocks is below the level at which marginal products of capital equal r^w, it would be profitable for domestic households to borrow at r^w and use the proceeds for consumption. Thus, the partial capital mobility constraint $B_{t+1} \geq -p_{k,t}^T K_{t+1}^T$ binds as long as households' initial quantity of assets, $K_0^T + K_0^N + B_0$, is less than the steady-state quantity of non-traded capital. As a result, the constraint becomes $B_{t+1} = -p_{k,t}^T K_{t+1}^T$.

[21] No-arbitrage condition also holds for non-traded capital sector. That is, $1 + i_t = \frac{p_{k,t+1}^N + rr_{t+1}^N}{p_{k,t}^N}$. Due to partial capital mobility, in general, $\frac{p_{k,t+1}^N + rr_{t+1}^N}{p_{k,t}^N} \neq \frac{p_{k,t+1}^T + rr_{t+1}^T}{p_{k,t}^T}$.

[22] Budget constraint implies that households' holdings of traded capital are automatically determined by the world capital market because $rr_t^T = r^w$. Thus, households only need to care about how much non-traded capital they should have.

$$p_{k,t}^N K_{t+1}^N = (p_{k,t}^N + rr_t^N)K_t^N + w_t L_t - \sum_{i=1}^n p_{i,t} C_{i,t} \tag{59}$$

Household maximizes utility given in (1) facing the sequence of constraints (3), (4), (5) and (59). Euler equation and a set of intertemporal first-order conditions with respect to consumption of good i and non-traded capital together with no-arbitrage condition for non-traded capital yield the same intertemporal relationship for aggregate consumption expenditure given as the equation (21) in the closed economy case. If we iterate the budget constraint (59) forward, then we derive the following expression.

$$\sum_{s=t}^{\infty} Q_t^s C_s = (p_{k,t}^N + rr_t^N)K_t^N + h_t \tag{60}$$

where $h_t = \sum_{s=t}^{\infty} Q_t^s w_s L_s$. We define total wealth in this small open economy under partial capital mobility, W_t^N, as the following.

$$W_t^N = (p_{k,t}^N + rr_t^N)K_t^N + h_t \tag{61}$$

Equations (21), (60) and (61) put together yield the solution to the household problem. The solution is again to spend a fixed portion of total wealth on consumption. Aggregate consumption expenditure is given by the following.

$$C_t = (1 - \beta)W_t^N \tag{62}$$

Partial capital mobility implies that the rate of return on traded capital (rr_t^T) is equal to the world interest rate at all points in time as traded capital serves as collateral. Thus, from the production function (3), we get $K_{i,t}^T = \dfrac{\alpha\theta a_i Y_{i,t}}{r^w}$. Using this, we derive the reduced-form production function for small open economy as the following.

$$Y_{i,t} = B_i(K_{i,t}^N)^{\gamma_i} X_{i,t}^{\delta_i} \tag{63}$$

where $B_i \equiv \dfrac{a_i}{A^{1-\alpha\theta a_i}} \left(\dfrac{\alpha\theta a_i}{r^w}\right)^{\frac{\alpha\theta a_i}{1-\alpha\theta a_i}}$, $\gamma_i \equiv \dfrac{\alpha(1-\theta)a_i}{1-\alpha\theta a_i}$ and $\delta_i \equiv \dfrac{b_i}{1-\alpha\theta a_i}$.

The profit for the firm producing ith commodity is given by the following.

$$\pi_{i,t} = p_{i,t}\, B_i\, (K_{i,t}^N\,)^{\gamma_i}\, X_{i,t}^{\delta_i} - w_t\, L_{i,t} - rr_t^N\, K_{i,t}^N \tag{64}$$

Firms maximize profits taking $p_{i,t}$, w_t, rr_t^N and q_t as given. Each firm solves the following problem.

$$\max_{\{K_{i,t}^N, X_{i,t}, L_{i,t}\}} p_{i,t}\, B_i\, (K_{i,t}^N\,)^{\gamma_i}\, X_{i,t}^{\delta_i} - w_t\, L_{i,t} - rr_t^N\, K_{i,t}^N \tag{65}$$

such that

$$L_{i,t} = X_{i,t} + V_{i,t} \tag{13}$$

$$L_{i,t} = q_t\, V_{i,t} \tag{14}$$

Using (15), we can derive the reduced form expression for profits as the following.

$$\pi_{i,t} = p_{i,t}\, B_i\, \varnothing_t^{\delta_i}\, (K_{i,t}^N\,)^{\gamma_i}\, L_{i,t}^{\delta_i} - w_t\, L_{i,t} - rr_t^N\, K_{i,t}^N \tag{66}$$

Firm's profit maximization equates the marginal products to the rental rate. Thus, we have the following first-order conditions in the small open economy under partial capital mobility.

$$\gamma_i p_{i,t}\, Y_{i,t} = rr_t^N\, K_{i,t}^N \tag{67}$$

$$\delta_i p_{i,t}\, Y_{i,t} = w_t\, L_{i,t} \tag{68}$$

1) Deriving the Aggregate Supply Equation

Following the same procedure in subsection 3.2.1, we can derive the following expression by substituting equation (30) into (68).

$$\delta_i g_i Z_t = w_t\, L_{i,t} \tag{69}$$

Summing equation (69) over all industries produces the following equation which describes the relationship between aggregate supply and the level of employment.

$$Z_t = \frac{1}{\delta} L_t \qquad (70)$$

where $\delta \equiv \sum_{i=1}^{n} \delta_i g_i$. If we substitute equation (30) into (67) and sum over all industries, then we have the following expression for non-traded capital.

$$\Phi Z_t = r r_t^N K_t^N \qquad (71)$$

where $\Phi \equiv \sum_{i=1}^{n} \gamma_i g_i$.

2) Deriving the Aggregate Demand Equation

The consumption Euler equation (21) combined with equation (71), no-arbitrage condition for non-traded capital and aggregate market clearing condition ($Z_t = C_t$.) is expressed as the following.[23]

$$\frac{1}{Z_t} = \frac{\beta}{Z_{t+1}} \left(\frac{p_{k,t+1}^N}{p_{k,t}^N} \right) + \frac{\beta}{p_{k,t}^N} \left(\frac{\Phi}{1-\theta} \right) \qquad (72)$$

We iterate forward equation (72). Then, we can derive the equation describing the relationship between aggregate demand and non-traded asset prices.

$$Z_t = \left\{ \frac{(1-\beta)(1-\theta)}{\beta \Phi} \right\} p_{k,t}^N \qquad (73)$$

Now we define the set of feasible expectations in the small open economy under partial capital mobility using (70) and (73) as the following.

Definition of Long-Term Expectations: The small open economy under partial capital mobility has a bounded state of long-term expectations which is defined

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[23] When deriving (72), remember that $K_{t=1}$. That is, $K_t^T = \theta$, and $K_t^T = 1 - \theta$.

by a non-negative sequence $\{p_{k,s}^{N}\}_{s=t}^{\infty}$ such that $p_{k,s}^{N} < \dfrac{\beta\phi}{(1-\beta)(1-\theta)\delta}$.[24]

   Equation (73) implies that the price of non-traded capital has direct influence on the aggregate economic activity of the small open economy under partial capital mobility. When people expect that non-traded capital has higher (lower) value in the future, the aggregate economic activity also gets stronger (weaker). This is why fluctuations in prices of non-traded capital such as house prices are critical in understanding the business cycles of the small open economy that is constrained by partial capital mobility. Houses are de facto non-traded capital even though they are in fact traded internationally. For instance, in Korean capital market, most of foreign investors strongly prefer purchasing stocks and bonds to purchasing real estate asset such as land and houses. It is legally possible for foreigners to purchase Korean real estate, but purchasing real estate asset involves much bigger transaction costs such as legal regulation and complicated tax structure than purchasing stocks and bonds does. This is why we can argue that real estate assets such as houses and land are to be taken as non-traded asset. Equation (73) can be rewritten in the following.

$$Z_t = \left\{\frac{1-\beta}{\alpha\beta\Psi(\theta)}\right\}p_{k,t}^{N} \tag{74}$$

where $\Psi(\theta) \equiv \Sigma_{i=1}^{n}\left(\dfrac{a_i g_i}{1-\alpha\theta\alpha_i}\right)$ and $\Psi'(\theta) > 0$. Equation (74) implies that the value of non-traded capital becomes less (more) influential on the level of economic activity when θ rises (falls). In this model θ represents the degree of openness. Given the sequence of long-term expectations about the price of non-traded capital, $\{p_{k,s}^{N}\}_{s=t}^{\infty}$, changes in the value of non-traded capital become less influential on the aggregate economy when the economy is more open to the world capital market. Instead, the value of traded capital such as stocks and bonds become more influential. It is widely known that Korean capital market is highly integrated with the world capital market, which implies that the price of non-traded capital such as house prices is less influential on the aggregate economic activity. However, more than 70 percent of households'

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[24] The maximum value of L_t is one. This implies that Z_t is bounded by δ^{-1} from equation (70). Thus, equation (73) implies that $p_{k,t}^{N}$ is bounded by $\dfrac{\beta\Phi}{(1-\beta)(1-\theta)\delta}$ for all t.

wealth in Korea is held in the form of real estate asset, mainly in the form of houses although the capital market is significantly open and developed. In this case, we can argue that the value of non-traded asset such as houses is still able to significantly influence the aggregate economic activity. This is why the depression in the prices of non-traded assets such as houses has much more profound impact on the business cycles of small open economy like the Korean economy than it has on the large economy like the U.S. in which households hold more than half of their wealth in the form of traded assets such as stocks and bonds. Thus, the closed economy version of aggregate demand equation (38) is more proper with the U.S. economy while the open economy version of aggregate demand equation (73) or (74) is more consistent with the open economy like the Korean economy.

Equations (69) and (74) together determine the allocation of labor inputs across industries as the following.

$$L_{i,t} = \frac{(1-\beta)\delta_i g_i}{\alpha\beta\psi(\theta)} p_{k,t}^N \tag{75}$$

Summing equation (75) over all industries brings us aggregate employment in Keynesian equilibrium that depends on the value of non-traded capital and the degree of openness as the following.

$$L_t = \frac{\delta(1-\beta)}{\alpha\beta\psi(\theta)} p_{k,t}^N \tag{76}$$

Equations (30), (67) and (71) determine the allocation of non-traded capital inputs across industries as the following.

$$K_{i,t}^N = \frac{(1-\theta)\gamma_i g_i}{\phi} \tag{77}$$

Once the allocation of labor inputs and non-traded capital inputs across industries are determined, the allocation of traded capital inputs across industries is trivially determined due to the partial capital mobility.

$$K_{i,t}^T = \frac{\theta\alpha a_i Y_{i,t}}{r^w} \tag{78}$$

3) Efficiency of Equilibrium

Equations (75), (76), (77) and (78) describe the allocations of factor inputs across industries in Keynesian equilibrium. We can see from equations (73), (74) or (76) that there is a continuum of Keynesian equilibria indexed by $p_{k,t}^N$. Due to the externality arising in the labor search process, Keynesian equilibrium fails to maintain full employment allocations of resources that would be chosen by a social planner. The solution to the social planner's problem in the open economy case gives us an implication about how likely it is for individuals to form depressed (or optimistic) expectations about future value of non-traded asset compared to the closed economy case. Social planner's problem in the small open economy under partial capital mobility is defined as the following.

$$\max_{\{C_{i,s}, X_{i,s}, V_{i,s}, L_s, V_s\}} J_t = \sum_{s=t}^{\infty} \left[\beta^{s-t} \sum_{i=1}^{n} g_i \log(C_{i,s}) \right] \tag{79}$$

such that

$$C_{i,s} \le B_i (K_{i,s}^N)^{\gamma i} X_{i,s}^{\delta_i} \qquad (s = 1, ..., \infty) \tag{80}$$

$$L_{i,s} = X_{i,s} + V_{i,s} \qquad (s = t, ..., \infty) \tag{81}$$

$$\sum_{i=1}^{n} L_{i,s} = L_s \qquad (s = t, ..., \infty) \tag{82}$$

$$\sum_{i=1}^{n} K_{i,s}^N = 1 - \theta \qquad (s = t, ..., \infty) \tag{83}$$

$$\sum_{i=1}^{n} V_{i,s} = V_s \qquad (s = t, ..., \infty) \tag{84}$$

$$L_s = (\Gamma V_s)^{1-\eta} \qquad (s = t, ..., \infty) \tag{85}$$

$$L_{i,s} = \left(\frac{V_{i,s}}{V_s} \right) L_s \qquad (s = t, ..., \infty) \tag{86}$$

We redefine the social planner's problem by taking equation (41) into account.

$$\max_{\{C_{i,s}, L_{i,s}, L_s\}} J_t = \sum_{s=t}^{\infty} \left[\beta^{s-t} \sum_{i=1}^{n} g_i \log(C_{i,s}) \right] \tag{87}$$

such that

$$C_{i,s} \le B_i (K_{i,s}^N)^{\gamma i} \left(L_{i,s} \left(1 - \frac{L_s}{\Gamma} \right) \right)^{\delta i} \qquad (i = 1, ..., n) \tag{88}$$

$$\sum_{i=1}^{n} L_{i,s} = L_s \qquad (s = t, ..., \infty) \tag{89}$$

$$\sum_{i=1}^{n} K_{i,s}^N = 1 - \theta \qquad (s = t, ..., \infty) \tag{90}$$

Solutions to the social planner's problem are given in the following.[25]

$$L_s = \frac{\Gamma}{2}, \qquad (s = t, ..., \infty) \tag{91}$$

$$L_{i,s} = \frac{\delta_i g_i}{\delta} L_s, \qquad (s = t, ..., \infty) \tag{92}$$

$$K_{i,s}^N = \frac{(1-\theta)\gamma_i g_i}{\phi} \qquad (s = t, ..., \infty) \tag{93}$$

$$K_{i,s}^T = \frac{\theta \alpha a_i Y_{i,s}}{r^w} \qquad (s = t, ..., \infty) \tag{94}$$

where $\delta \equiv \sum_{i=1}^{n} \delta_i g_i$ and $\Phi \equiv \sum_{i=1}^{n} \gamma_i g_i$

Socially optimal level of aggregate employment is given as (91). The aggregate employment in the Keynesian equilibrium given as equation (76) and depends on the long-term expectations about the value of non-traded capital. Obviously, it is in general different from the socially optimal level of aggregate employment given as equation (91). Thus, almost all of the Keynesian equilibria are inefficient. Using equations (76) and (91), we can derive a special value for $p_{k,t}^N$ where the Keynesian equilibrium implements the social planning

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[25] See the Appendix for the derivation of the solutions to the social planner's problem.

optimum in the following.

$$\left(p_k^N\right)^* = \frac{\alpha\beta\Gamma}{2(1-\beta)\delta}\Psi(\theta) \tag{95}$$

If $p_{k,t}^N < (p_k^N)^*$, the economy may have inefficiently high unemployment $\left(L_t < L^* = \dfrac{\Gamma}{2}\right)$, and the economy is in recession. If $p_{k,t}^N > (p_k^N)^*$, the economy may have inefficiently low unemployment $\left(L_t > L^* = \dfrac{\Gamma}{2}\right)$, and the economy is overheated. This implication is the same as we derive from the closed economy case. However, in the open economy case, $\left(p_k^N\right)^*$ depends on the degree of openness while p_k^* in the closed economy case is constant. When an economy is more integrated with the world economy, that is, when θ rises, $\left(p_k^N\right)^*$ also rises. Higher value for $\left(p_k^N\right)^*$ means that $p_{k,t}^N$ is more likely to fall short of $\left(p_k^N\right)^*$. In other words, given the sequence of long-term expectations about the future value of non-traded capital, households become more likely to form pessimistic self-fulfilling expectations about the value of non-traded capital when θ rises.[26] This implies that the economy is more likely to have inefficiently high unemployment and suffer from the recession when θ rises. Therefore, it is more crucial for the government or the central bank to control the prices of non-traded asset such as houses and land when the economy gets more open to the rest of the world because the risk of households' having pessimistic self-fulfilling expectations about the asset prices gets bigger. The government or the central bank should be active in having households escape from pessimistic trap of self-fulfilling expectations.[27]

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[26] We can express this idea more formally in the following. $Pr\left(p_{k,t}^N < (p_{k,t}^N)^*_{\theta_1}\right) < Pr\left(p_{k,t}^N < (p_{k,t}^N)^*_{\theta_2}\right\}$ if $\theta_1 < \theta_2$

[27] Note that the value of θ has some policy implication on the dynamic property of the model. When θ rises, the equation (74) implies that the price of non-traded capital has less influence on the aggregate activity. Thus, it is less necessary for the government or the central bank to control the price of non-traded capital. When θ rises, on the other hand, the equation (95) implies that the likelihood of people forming pessimistic self-fulfilling expectations also increases, which means that the economy is more likely to fall into the economic downturn caused by pessimistic self-fulfilling expectations and suffers from the inefficiently high unemployment. This implies that it is more crucial for the government or the central bank to control the value of non-traded capital when θ rises. So we can see that there might be a nonlinear relationship between the value

As we see in Figure 9, households in the Korean economy hold 70 percent of their wealth in the form of housing asset which is taken as non-traded capital in this model. It implies that changes in the price of non-traded capital may have critical influence on the aggregate economic activity in the Korean economy. Furthermore, there are even higher chances that Korean households may form pessimistic self-fulfilling expectations about the non-traded asset prices as the Korean capital market becomes more integrated with the rest of the world as implied by the discussion so far. In fact, deep recession in the Korean economy in recent years is associated with a serious fall in the prices of houses. This phenomenon is well explained by the model proposed in this paper. It is not only the price of traded capital such as stock but also the price of non-traded capital such as houses that heavily influences the aggregate economic activity and the level of employment in the Korean economy. Figure 14 illustrates the Keynesian explanation on what happened to the Korean economy since the 2008 crash.[28] In 2008 when the world economy was hit by a massive negative shock caused by the global financial crisis, the Korean households lost their confidence not only on the price of traded asset (stocks) but also the price of non-traded asset (houses). It caused a self-fulfilling fall in house prices and a subsequent drop in house purchase, which even caused a further fall in house prices. Thus, we can argue that the most effective policy measures for the Korean government or Bank of Korea to reinvigorate the

of θ and the relative importance of government policy intervention in the non-traded capital market. I guess that this issue is related with the dynamic property of the model depending on the value of θ. There would be a critical value of θ' which bifurcates the dynamic property of the model. That is, the dynamic property of the model would show a saddle-path property when θ is less than θ', which eliminates the possibility of equilibrium indeterminacy. In this case, the self-fulfilling expectations about the non-traded asset price have no meaningful influence on the economy. Thus, the government doesn't need to pay much attention to house prices. On the other hand, when θ is bigger than θ', the dynamic property of the model would show the stability around the steady states, which means that self-fulfilling beliefs about the non-traded capital price play an important role in the business cycles of small open economy. In this case, the government policy matters to stabilize the macroeconomy by soft-landing the non-traded asset price. I plan to look into this issue in more detail in the next paper which will be the sequel to the current paper.

[28] One may think that Figure 14 can be simply drawn from the usual *AD-AS* model. In fact, Figure 14 and the usual *AD-AS* curve are fundamentally different because the relationship between aggregate demand (Z) in this paper which is a function of asset price and aggregate supply $\left(\frac{1}{\delta}L\right)$ comes from the first-order conditions resulted from the dynamic optimization by households and firms. Put differently, Figure 14 has a solid micro-foundation, while the usual *AD-AS* curve doesn't.

Korean economy is to boost up the price of non-traded capital, that is, house prices by a reasonable magnitude in order to soft-land the housing market. Unless households revise their long-term expectations about the price of non-traded asset from pessimistic to optimistic, the aggregate economic activity may continue to stagnate for a considerable time.

   Certainly, self-fulfilling beliefs about asset prices are not the only factors that caused the Great Recession. There should be other real factors that are supposed to cause the Great Recession, for instance, slowdown in productivity growth or lower population growth. However, self-fulfilling beliefs about house prices magnified the initial fall in house prices and made the crisis even worse, which froze the capital market. Frozen capital market had devastating influences on the real economy. In terms of Figure 14, the fall in aggregate economic activity from Z_{2008} to Z_{2012} was not caused solely by the deteriorations in self-fulfilling expectations on house prices, but a considerable size of the fall could be caused by the deteriorations in self-fulfilling beliefs on house prices. I argue that the fall from Z_{2008} to Z_{2012} (or the price fall from $p_{k,2008}^{N}$ to $p_{k,2012}^{N}$) is too excessive and inefficient because the fall was magnified by self-fulfilling expectations of investors, i.e., animal spirits of investors that are not related with the fundamentals of the economy. Thus, I argue that it is necessary for the government to implement a policy to recover the fall in house price partially, not fully, only to the extent that the fall was too excessive and inefficient. This limited recover in house prices would be welfare-improving because the fall

Figure 14. The Keynesian Explanation to the Korean Economy since the 2008 Crash
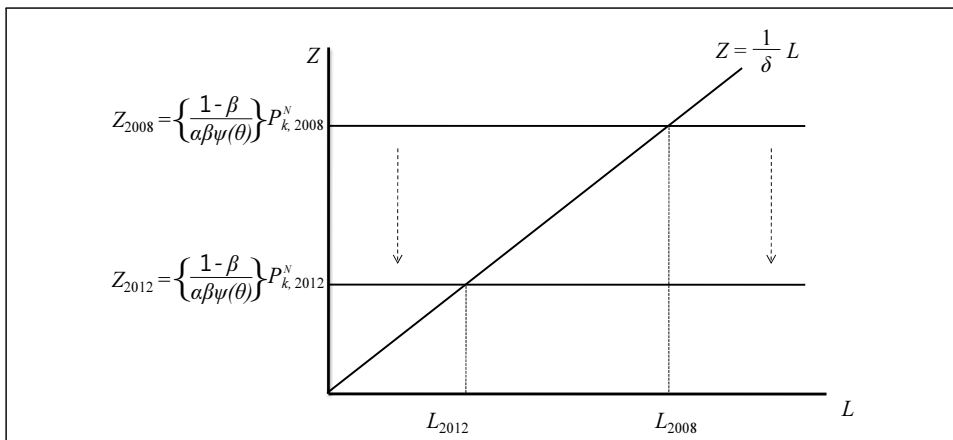
was too excessive and unrelated with the fundamentals. This is what I think is the soft-landing of the housing market, which is stabilizing the housing price somewhere between $p_{k,2008}^{N}$ and $p_{k,2012}^{N}$.

IV. Conclusion

The effectiveness of macroeconomic way of thinking based on the efficient market hypothesis is being challenged since the world economy was hit by the global financial crisis in 2008. The Great Depression gave birth to the economics of Keynes and the Great Recession since the 2008 crash may be an event that would shed new lights on the economics of Keynes which was almost forgotten at least in the academic field since the stagflation in the 1970s. The economics of Keynes stresses the role of the government and the animal spirits of investors in understanding the business cycles of an economy. The real business cycle theory and new-Keynesian economics that basically rely on the efficient market idea of classical economics seem to be unable to explain the Great Recession nor to propose an appropriate policy measures to save the economy out of the Great Recession. Thus, the Keynesian approach would be the appropriate paradigm in which we understand the Great Recession and devise a relevant policy option. However, one serious problem with the economics of Keynes is that it lacks the microeconomic foundations. The model proposed by Farmer (2012) leads us to a new way of understanding the economics of Keynes from the perspective of a micro-foundation. Farmer (2012) shows that the aggregate economic activity is directly associated with the long-term expectations of the public about the future values of assets such as stocks.

This argument makes sense with the economy such as the U.S. economy where households hold a significant portion of their wealth in the form of stocks. But for a small open economy like the Korean economy, the story may be a little different. More than 70 percent of household wealth is held in the form of housing assets in the Korean economy. In this case, it may be the prices of houses that are more influential on the aggregate economic activity rather than the stock prices. In order to capture this point, a two-sector small open economy model is developed in this paper. The economy has two kinds of capital, traded capital such as stocks and non-traded capital such as houses. The model shows that the aggregate economic activity is explicitly associated with the long-term expectations of the public about the future value of non-traded capital, i.e., house prices. Furthermore, it shows that the public is more likely to form pessimistic

self-fulfilling expectations about the future asset prices as the economy becomes more integrated with the rest of the world. In Keynes' words, animal spirits of investors become even more powerful in driving the economy into a recession when the economy is open rather than it is closed. This implies that the government and the central bank of a small open economy such as Korea must carefully watch what happens to the price of non-traded assets such as houses and implement an appropriate fiscal and monetary policy to stabilize (or soft-land) the non-traded asset prices in order to prevent the economy from falling into a full-fledged depression like the Great Depression.

This paper aims to prove theoretically that self-fulfilling beliefs about non-traded capital prices such as house prices play an important role in the business fluctuations of small open economy. In order to empirically apply this theoretical model to the actual small open economy such as the Korean economy, we need to develop the model further and derive a modified *IS-LM* model which must be based on dynamic optimization by economic agents as is done in this work. This modified *IS-LM* model fundamentally differs from the usual textbook *IS-LM* model in the sense that the former has a solid micro-foundation. Given an arbitrary level of non-traded capital price, the modified *IS-LM* curve would be derived by managing first-order conditions of households and no-arbitrage condition for non-traded capital sector. We may add fiscal and monetary policy variable in a proper way onto the modified *IS-LM* model. After calibrating the model using the Korean data, then we will be able to empirically analyze the effects of fiscal and monetary policy to stabilize the Korean economy hit by self-fulfilling deteriorations of house prices.

Appendix

Let $\lambda_{i,s}$ be the multiplier on the ith constraint on (88) at date s, μ_s be the multiplier on the constraint (89), and ξ_s be the multiplier on the constraint (90). The first-order conditions to the social planner's problem (87) are given as the following.

$$\beta^{s-t} g_i = \lambda_{i,s} C_{i,s} \tag{A.1}$$

$$\lambda_{i,s} \delta_i C_{i,s} = \mu_s L_{i,s} \tag{A.2}$$

$$\sum_{i=1}^{n} \lambda_{i,s} \delta_i C_{i,s} = (\Gamma - L_s)\mu_s \tag{A.3}$$

$$\lambda_{i,s} \gamma_i C_{i,s} = \xi_s K_{i,s}^{N} \tag{A.4}$$

If we combine equation (A.1) with equation (A.2) and sum across industries, we have the following.

$$\beta^{(s-t)} \delta = \mu_s L_s \tag{A.5}$$

Combining equation (A.1) with equation (A.3) yields the following.

$$\beta^{(s-t)} \delta = (\Gamma - L_s)\mu_s \tag{A.6}$$

We can derive the socially optimal level of employment from equations (A.5) and (A.6) as in equation (91). Combining equations (A.1), (A.2), and (A.5) yields the allocations of labor input across industries as in equation (92).

If we combine equation (A.1) with (A.4) and sum across industries, then we derive the following.

$$\beta^{(s-t)} \Phi = \xi_s (1 - \theta) \tag{A.7}$$

We derive the following by combining (A.1) with (A.4).

$$\beta^{(s-t)} \gamma_i g_i = \xi_s K_{i,s}^{N} \tag{A.8}$$

Equations (A.7) and (A.8) together yield the allocations of non-traded capital input across industries as in equation (93). Once the allocations of labor inputs across industries are determined by equation (92) and the allocations of non-traded capital inputs across industries are determined by equation (93), the allocations of traded capital inputs is trivially determined by equation (94) due to the partial capital mobility.

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About the Author

Jong-Kyou Jeon has a Ph.D. in economics. He was educated in the Graduate School of Economics, University of California, Los Angeles, United States. He had served as a research fellow at Korea Institute for International Economic Policy. His areas of expertise include international business cycles, exchange rate economics, and financial market integration in East Asia. He has authored a number of journal articles on the equilibrium indeterminacy and business cycle features of small open economy, financial integration in East Asia, and the economic relation of Korea with other countries. At present he is professor of economics at the College of International Studies at Kyung Hee University, Yong-in, the Republic of Korea.