

March 10, 2015

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Frictionless Models in a World Full of Frictions

“Architecture starts when you carefully put two bricks together. There it begins.”
Ludwig Mies Van der Rohe

Economic and business theories provide useful guidelines to decision makers. Almost every major central bank around the globe, along with international organizations such as the IMF and the World Bank, utilize large-scale econometric models (also known as macro-models) to guide decision making. These models attempt to characterize the behavior of certain agents, including consumers, investors and public policy makers. One of the central assumptions behind most of the macro-models in use today is that all agents in the model are in a state of equilibrium simultaneously, which creates a general equilibrium and implies a frictionless model. The Great Recession, financial crisis and the recent plunge in oil prices (along with several other events—debt and currency crises, for example) have forced some economists to look beyond frictionless models and find some alternatives to help decision makers. This report is the first of a three-part series in which we discuss some of these models with and without frictions. This first part presents theoretical foundations of macro-models with frictions and, in the second and third parts, we will characterize the equilibrium states of different sectors and markets.

In our view, frictions exist, and in the presence of frictions, frictionless models may not provide an accurate assessment of the economy. As a result, policy recommendations based on frictionless models could lead to misguided decisions and unanticipated outcomes.

In any economy, the goals of monetary and fiscal policy decisions change with the business cycle, and policy intervention is sometimes necessary to restore equilibrium in some sectors of the economy. By allowing frictions in macro-models, policymakers would be more able to accurately assess the state of an economy and suggest appropriate policies. In the case of the U.S. economy, a number of policies fell short in the wake of the Great Recession due to a lack of acknowledgement of frictions. For example, while theory suggested that significant fiscal stimulus and a zero interest rate policy would jumpstart economic growth, uncertainty among consumers and businesses about financial regulation was an unforeseen friction, holding back credit markets and choking off the recovery.

“The Truth is in the Details”: Micro-foundations of a Macro-model

Standard macro-models consist of several blocks (sectors) and each block represents different aspects of the economy. Typical blocks of macro-models are 1) aggregate demand (AD), 2) aggregate supply (AS), 3) prices and 4) policy.¹ The aggregate demand block consists of the spending decisions of economic agents (consumers, investors and government, for example), while the aggregate supply block evolves from the price-setting decisions of firms and the leisure/work decisions of households. Policy actions are included in the macro-models through the policy block. Some assumptions are crucial to understand the structure and output of a macro-model. For example, one assumption of the model is that microeconomics is the foundation of the AD and AS blocks. That is, decisions in the AD and AS blocks are based on a

The Great Recession has challenged the traditional frictionless macro-model.

¹ For a survey of macro-models see; Gali, Jordi and Gertler, Mark. (2007). Macroeconomic Modeling for Monetary Policy Evaluation. *Journal of Economic Perspectives*, Vol 21 (4), Fall 2007.



representative consumer and a firm. Another assumption states that different markets in the model are in equilibrium, or frictionless, in the long run.² These two assumptions are important, as they may be violated in the short run or in practice, causing frictions. Furthermore, decision makers would need a different set of policy tools to address short-run frictions.

The micro-foundations assumption, which states that a representative household/firm is the decision maker, implicitly assumes preferences such that expectations are identical within a group of economic agents.³ The benefit of this assumption is that it makes determining equilibrium less complicated, as only one set of preferences for the household/firm is needed to represent the preferences of all agents in the model and thus determine the AD/AS blocks.

Figure 1

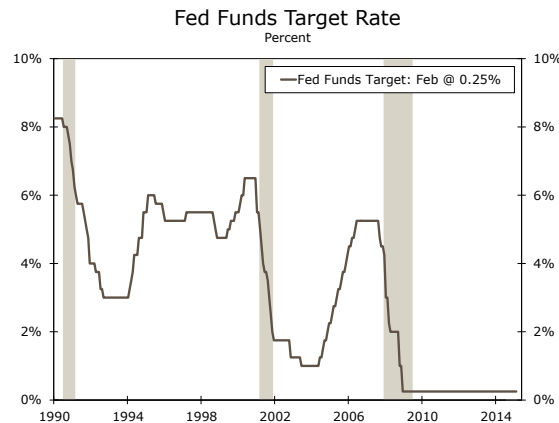
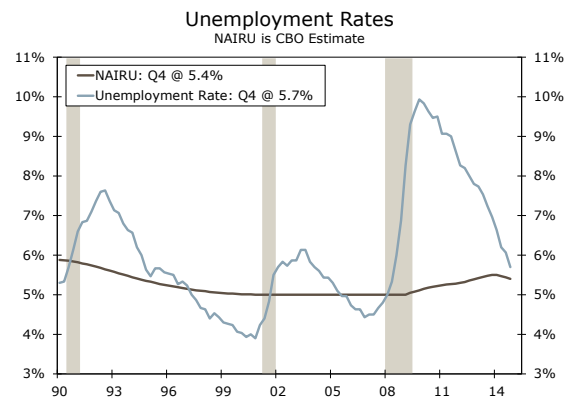


Figure 2



Source: Federal Reserve Board, U.S. Dept. of Labor, CBO and Wells Fargo Securities, LLC

“Animal spirits” are a key cause of frictions and can compromise equilibrium.

In reality, however, preferences and expectations are not identical within a group of economic agents (consumers and investors, for example). These discrepancies, which Keynes originally called “animal spirits,” may create frictions (disequilibrium or partial equilibrium) in the model, at least in the short run.⁴ As a result of animal spirits, one segment of economic agents may be more optimistic (or pessimistic) about the economy than another segment of agents. This optimism (or pessimism) among certain agents may create a bubble (or bust) in that economy. Recessions provide us with undeniable evidence of frictions. Some recessions, such as the Great Recession, might represent a structural break, in the sense that equilibrium may have shifted upward or downward for some sectors, or perhaps the entirety, of an economy.

For example, in response to the Great Recession, the Federal Open Market Committee (FOMC) brought down the federal funds target rate to an unprecedented 0.00-0.25 percent range, and the rate has been in that range since December 2008 (Figure 1). The unemployment rate has been above the natural level, given by the non-accelerating inflation rate of unemployment (NAIRU), for a longer period than in prior recoveries, another example of disequilibrium (Figure 2). Moreover, movements from one equilibrium to another are unlikely to be smooth, which further reiterates the importance of frictions. In sum, frictions are possible in the short run, and some short-run frictions even have the ability to shift the longer-run equilibrium. In the current cycle, one obvious friction is the high number of employees who are working part-time for economic reasons and would desire a full-time job (Figure 3). Another illustration of market frictions is the outward shift in the Beveridge curve. This shift signals that at any given level of unemployed workers, there is a higher level of vacancies that firms cannot fill (Figure 4).

² There are several other assumptions of a macro-model—see Gali and Gertler (2007) for more details. In this report, we concentrate on these two assumptions and show why decision makers should include alternatives of these assumptions in decision making.

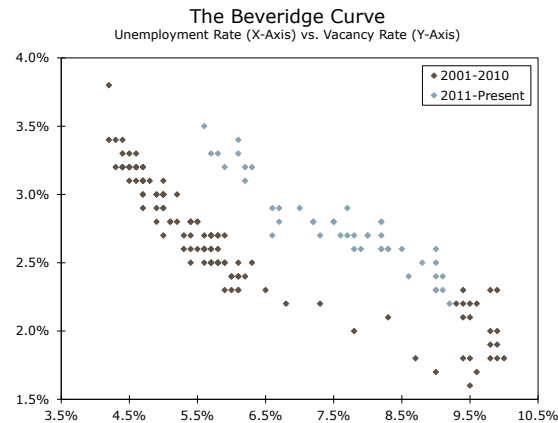
³ Another way of thinking would be to assume average preferences between consumers (or investors) are identical. This would also create the same problem, however—frictionless models.

⁴ Akerlof, G.A. and Shiller, R. (2009). *Animal Spirits: How Human Psychology Drives the Economy, and why it Matters for Global Capitalism.* Princeton University Press, New Jersey, USA.

Figure 3



Figure 4



Source: U.S. Department of Labor and Wells Fargo Securities, LLC

How Markets Function: Textbook Equilibrium

An economy consists of several markets (e.g., labor, housing and money markets), and interactions between different economic agents determine equilibrium in these markets. Most economies are also open to international trade, thereby making the foreign exchange and trade markets another important factor. To understand how these markets function, we raise a few critical questions. What determines equilibrium in a market? What drives a market away from the equilibrium? How can equilibrium (or disequilibrium) in one market affect equilibrium in another market? In the standard textbook approach, a market (the labor market for example) is in equilibrium when quantity demanded (demand) is equal to quantity supplied (supply), *ceteris paribus*. Furthermore, this scenario of equilibrium supply and demand determines an equilibrium price (or wage rate, in the case of the labor market). Put differently, equilibrium in the labor market indicates market participants (workers and employers) have obtained what they were seeking. That is, workers who are willing to work at the equilibrium wage rate (W^* for example) would find work. By the same token, employers who are offering W^* wage would find workers.

There are several crucial points we want to stress with this simple but intuitive example. First, we can typically divide participants of a market into two groups, which are demand (user) and supply (provider).⁵ Second, decisions from these two groups determine equilibrium. Third, resources are optimally utilized in the market, as quantity demanded equals quantity supplied. Next, the equilibrium price (W^*) does not imply a constant equilibrium value, as it may change over time. In addition, the equilibrium concept represents a stable path, and if one side of the market (demand, for example) changes, then the equilibrium value (W^*) would also change to equalize supply and demand and restore equilibrium. The final point divides changes in equilibrium states into two groups. For example, if quantity supplied (supply) increases, then the equilibrium would fall to re-equate supply and quantity demanded (demand). In the textbook sense, this scenario is known as “a movement along the curve.” That is, if the equilibrium value changes due to the intra-market factors, then it is a movement along the curve. On the other hand, if equilibrium changes due to external factors (outside the market), then it is a “shift in the curve.” Both changes would require different policy actions from decision makers if policy makers desire a different outcome than that determined by the market. We shed light on this topic in the next section.

Equilibrium in the “textbook” definition occurs when supply equals demand.

Equilibrium changes can be movements along the curve or shifts in the curve.

⁵ For the sake of simplicity, we utilize the words demand/user and supply/provider interchangeably. In some cases, a user may also be a provider. In the case of labor market, a worker is seeking a job but also providing supply of labor. Similarly, an employer is providing a job but also seeking a worker. The point we stress is that we need two sets of decisions to achieve equilibrium.

Figure 5

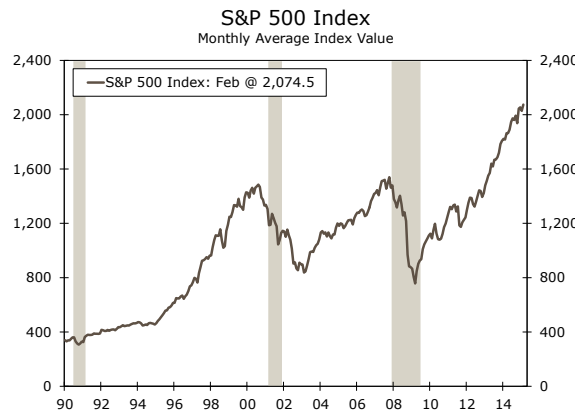
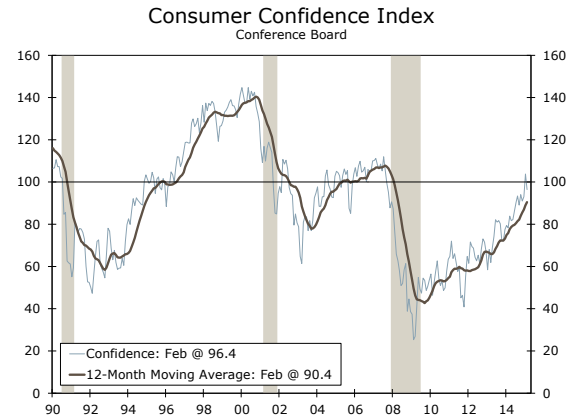


Figure 6



Source: IHS Global Insight, Conference Board and Wells Fargo Securities, LLC

Frictions: “Creative Destruction” and Equilibrium States

A standard, frictionless, macro-model has good theoretical foundations; however, the model may be too simple for practical decision making. In practice, decision makers can design policies for the short run and long run. In the short run, markets experience shocks (internal and external), and those shocks create a state of disequilibrium. Frictions may be significant in preventing a smooth move to a new equilibrium and may further alter the potential future path of the relationship between variables of interest in search of a new equilibrium, forcing us to re-think the model’s existing theoretical foundations. A classic episode of such shocks and related market shocks (movements along the curve and shifts in the curve) has been observed recently. The Great Recession was a shock (a structural break) to the U.S. economy, and the effect of that shock was seen in every major sector of the economy. This begs the question: can we quantify a market’s distortions?

For some markets, there is more than one indicator to judge market disequilibrium. For instance, common measures to judge labor market performance are the unemployment rate, wage rate, monthly net change in nonfarm payrolls and the labor force participation rate. For interest rates, short-term rates (the fed funds target rate), long-term rates (the 10-year Treasury yield) or a combination of both (yield spreads) can be utilized to evaluate the market’s position relative to the equilibrium state.

There have been a number of sharp market adjustments in recent years. The first was the S&P 500 index, which dropped 51 percent between October 2007 and March 2009 (Figure 5). Another was the consumer confidence index, which dropped 77 percent between July 2007 and February 2009 (Figure 6). A final example is the federal funds target rate, which has been in the 0.00-0.25 percent range since 2008. There are many more examples of such market movements, and each can be associated with large market disequilibria that require adjustments by market actors. Yet, these actors are limited by frictions that limit the speed and completeness of adjustments.

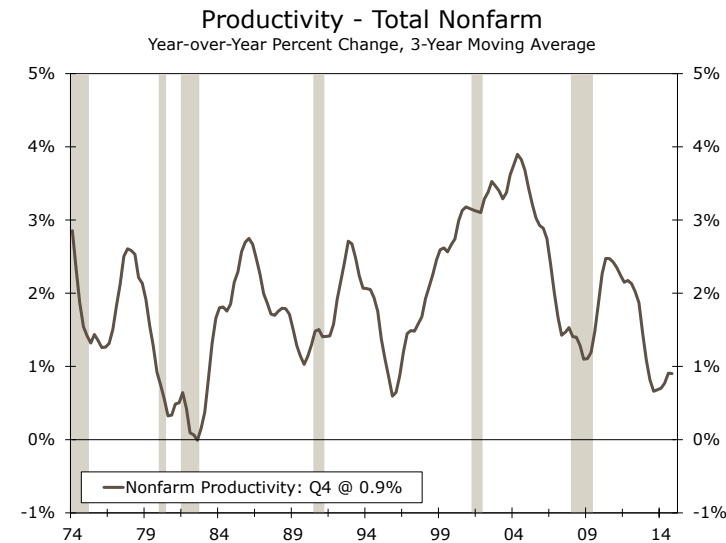
Not all shocks create negative or sudden effects. Some shocks may shift equilibria upward, and the effect on the markets may be gradual. Schumpeter (1942) developed the concept “creative destruction,” which suggests that new and improved technology not only replaces existing technology but also improves output, thus shifting equilibrium upward.⁶ One example of creative destruction (positive, gradual shock) is U.S. productivity growth since the mid-1990s (Figure 7). Some have used the term “productivity resurgence” to describe the post-1995 era, as U.S. productivity growth has picked up since 1996. The average productivity growth rate from 1996-2014 is 2.24 percent, higher than the average growth rate during 1974-1995 of 1.46 percent.

⁶ For more detail about creative destruction see, Schumpeter, Joseph. (1942). “*Capitalism, Socialism and Democracy*.” Routledge, London.

Recent market distortions suggest that frictions exist in practice.

Some analysts suggest information technology (the Internet and personal computers, for example) is one of the major sources of productivity resurgence.⁷

Figure 7



Source: U.S. Department of Labor and Wells Fargo Securities, LLC

In sum, due to shocks and frictions, markets disruptions can persist and the effects of a shock on a market's equilibrium can persist as well. In addition, a shock can shift a market's equilibrium upward or downward from the existing equilibrium state.

Why Do We Care about Frictions?

After establishing that frictions exist, the question arises: why do we care about frictions? For one, if a market is in disequilibrium, then it may imply that resources in the market are not being fully utilized. For example, labor market disequilibrium may suggest that some workers are unable to find jobs, some employers are unable to find workers or perhaps both parties are unable to find matches. Another aspect of frictions is that sometimes distortions need to be "fixed". That is, policy intervention (monetary or/and fiscal policy, for example) is required to bring the market back to a state of equilibrium.

A key point, which is crucial for decision makers, is that distortions in one market can affect other markets. Many economic and business theories corroborate this concept. For example, the Taylor rule suggests a relationship between interest rates, inflation and output, money neutrality implies a relationship between money supply and inflation (Figure 8) and the Phillips curve describes a link between unemployment rate and inflation.

Our takeaway is that there are relationships between different markets and therefore disequilibrium in one market will likely lead to further adjustments in other markets.⁸ We have also seen this in practice, as the housing sector was the epicenter of the Great Recession, but the labor market experienced the largest job loss in the post-WWII era (Figure 9). The unemployment rate stayed elevated for several years even after the official ending of the Great Recession. Furthermore, the fed funds target rate has been in the 0.00-0.25 percent range since December 2008. Finally, inflation rates are below the Fed's target of 2 percent. Therefore, distortions in one

Frictions can have a contagion effect.

⁷ For more detail about productivity resurgence see, Bernanke, Ben. (2005). Productivity. Available at: <http://www.federalreserve.gov/BoardDocs/speeches/2005/20050119/default.htm>

⁸ Barro, R. and Grossman, H. (1976). "Money Employment and Inflation." Cambridge University Press, Cambridge, London.

market can spread to others and also require policy interventions to restore equilibrium states in markets.

Figure 8

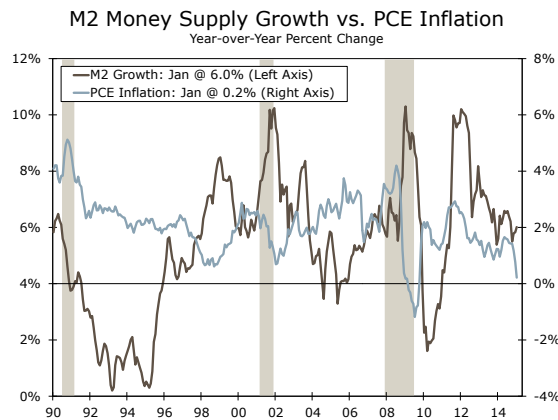
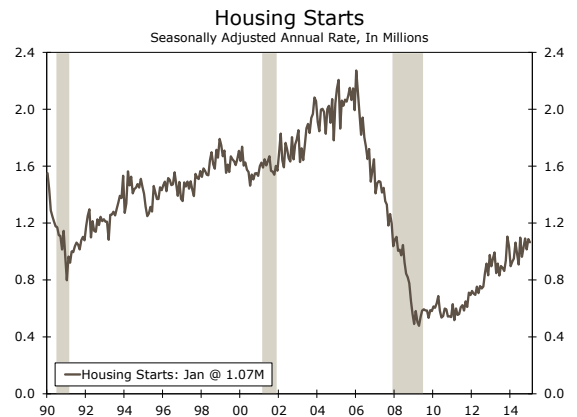


Figure 9



Source: U.S. Department of Commerce, Federal Reserve Board and Wells Fargo Securities, LLC

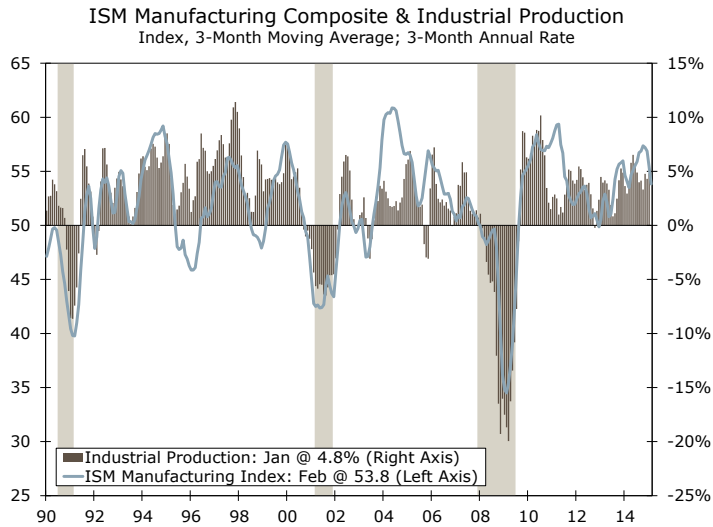
A final point we want to stress is the possibility of a partial equilibrium, instead of general equilibrium, in an economy. That is, it may be possible that some markets are in disequilibrium and others are in equilibrium, simultaneously, within an economy. For instance, inflation rates, interest rates and the labor market experienced distortions, but output and equity markets appear to be functioning without friction currently. Industrial production and the ISM manufacturing index are suggesting normal functioning in the manufacturing sector (Figure 10). Industrial production crossed its prerecession peak on October 2013, and has been in the expansionary phase since then. The ISM manufacturing index entered expansionary territory (above 50) in August 2009 and has been above 50 nearly every month since then (it dropped to 48.9 in November 2012). The S&P 500 index, a proxy for the equity market, crossed its prerecession peak in March 2013 and is currently near all-time highs. Therefore, it is safe to say the U.S. economy has been in partial equilibrium over the past few years, while the labor market remains in disequilibrium, as illustrated by the structural shift in the Beveridge curve.

For decision makers, the concepts of frictions and partial equilibrium are crucial since they need to assess (or forecast) the chances of an impending crisis and may need to design appropriate policy tools. Predicting a crisis is often extremely difficult, as suggested by Rudi Dornbusch, who said that a crisis “takes a much longer time coming than you think, and then it happens much faster than you would have thought.”⁹ However, by allowing for the possibility of frictions and partial equilibria in models, decision makers can improve the decision making process.

Allowing for frictions is crucial in helping us see an impending crisis.

⁹ Sometimes this is referred to as “Dornbusch’s Law”. For more detail about Dornbusch’s law, see; <http://www.pbs.org/wgbh/pages/frontline/shows/mexico/interviews/dornbusch.html>

Figure 10



Source: ISM, Federal Reserve Board and Wells Fargo Securities, LLC

Concluding Remarks: Frictionless Assumption Is not Harmless

Decision makers utilize many tools to analyze an economy, in particular for an impending crisis or an effect of a policy change on different sectors of an economy. One widely employed tool in today's decision making world is known as a macro-model. One of the key assumptions of a standard macro-model is frictionless movement of prices and goods and services.

However, frictions exist, and in the presence of frictions, frictionless models do not provide an accurate assessment of the economy. Certainly, this was true in the wake of the Great Recession. Furthermore, policy recommendations based on an incorrect assessment of the functioning of the economy would lead to poor decisions and disappointing results.

In sum, private and public policy decisions change with the business cycle and policy intervention is sometimes necessary to restore equilibrium in some markets of an economy. However, by allowing frictions in the macro-model, we can provide more accurate assessments of the state of the economy and suggest appropriate policy actions. In the case of the United States, during the past eight years, sector-specific policies have been hit and miss in their ability to restore equilibrium in their respective sectors due to the misreading of the actual functioning of the economy.

Frictionless models do not provide an accurate assessment of the economy.

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