Volume 17, Number 2

Print ISSN: 1533-3604
Online ISSN: 1533-3590

JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

Editor:
Tamer Rady
Ain State University

The *Journal of Economics and Economic Education Research* is owned and published by Jordan Whitney Enterprises, Inc. Editorial content is under the control of the Allied Academies, Inc., a non-profit association of scholars, whose purpose is to support and encourage research and the sharing and exchange of ideas and insights throughout the world.

Authors execute a publication permission agreement and assume all liabilities. Neither Jordan Whitney Enterprises nor Allied Academies is responsible for the content of the individual manuscripts. Any omissions or errors are the sole responsibility of the authors. The Editorial Board is responsible for the selection of manuscripts for publication from among those submitted for consideration. The Publishers accept final manuscripts in digital form and make adjustments solely for the purposes of pagination and organization.

The Journal of Economics and Economic Education Research is owned and published by Jordan Whitney Enterprises, Inc., PO Box 1032, Weaverville, NC 28787 USA. Those interested in communicating with the Journal, should contact the Executive Director of the Allied Academies at info@alliedacademies.org.

EDITORIAL REVIEW BOARD

TABLE OF CONTENTS

OPEN ECONOMY KEYNESIAN MACROECONOMICS WITHOUT THE LM CURVE

Oscar Bajo-Rubio, Universidad de Castilla-La Mancha
Carmen Díaz-Roldán, Universidad de Castilla-La Mancha

ABSTRACT

When teaching intermediate Macroeconomics, the integration of recent developments in the field of macroeconomic modelling and practice is not common. Some novelties such as the use of a monetary policy rule instead of the traditional LM function, an aggregate supply function based on the Phillips curve, and the extension of the open economies models to describe a monetary union have not been yet incorporated into most available manuals on the subject. There have been several attempts proposing to replace traditional assumptions. But most of them have focused just in one aspect and have been disseminated through academic papers or, in the best cases, incorporated as isolated case studies or discussions in a few textbooks.

In this paper, we present a novel framework for macroeconomic analysis, which tries to incorporate recent theoretical developments into an integrated model describing an open economy. The model includes a monetary policy rule instead of the LM function together with an aggregate supply function derived from the Phillips curve, and the model of the open economy is later extended to describe the case of a monetary union. This new approach should be useful for teaching purposes.

In our model, monetary policy is assumed to follow a rule, or MR function. According to this rule, the interest rate will be changed by the central bank as a function of the deviation of the current inflation rate from the target set by the monetary authority, and of the evolution of the level of output. Therefore, the MR function together with the traditional IS function, make the IS-MR model, alternative to the IS-LM model, from which we obtain the aggregate demand function, AD. Regarding aggregate supply, we include imperfect competition assumptions to stress the role of institutional aspects on economic evolution. Finally, from the Phillips curve so obtained, we derive the aggregate supply function, AS, and complete the AS-AD model, which now relates the level of output and the rate of inflation, instead of the price level.

Under this approach, a special attention is given to the open economy. When modelling the open economy we include two novelties: first, the real exchange rate is incorporated into the aggregate supply function; and, second, the IS-MR and AS-AD models are adapted to the case of a monetary union. In the model of the monetary union, her member countries are assumed to be identical, and each variable of the union is a weighted average of the corresponding variables of the union's member countries. The MR function will be the same for the whole union, which implies that, even though the nominal interest rate is common for the member countries of the union, the real interest rates will be different across them as long as the inflation rates are different too. Therefore, in our model, the open economies analysis is presented for the cases of flexible exchange rate and monetary union, instead of the standard cases of flexible and fixed exchange rate.

INTRODUCTION

Recent developments in the field of Macroeconomics have not been fully incorporated into the available textbooks. Certainly, the "canonical" New Keynesian model (see, e.g., Galí, 2008), currently representing the prevailing orthodoxy in academic circles, includes, together with an IS function, a monetary policy rule and an aggregate supply function based on the Phillips curve. However, the use with didactic purposes of a model of this kind when teaching intermediate Macroeconomics is not common.

In a paper published some years ago, David Romer proposed to replace "the LM curve, along with its assumption that the central bank targets the money supply, with an assumption that the central bank follows a real interest rate rule" (Romer, 2000, p. 150). Assuming the real interest rate is an increasing function of the inflation rate, he obtained an MP (for monetary policy) function, horizontal in the real interest rate-output space that, when coupled with a traditional IS function, led to a decreasing aggregate demand (AD) function in the inflation rate (instead of price level)-output space. The model was completed with the assumption that inflation rises when output is above its natural rate and falls when output is below its natural rate, which gave a horizontal inflation adjustment (IA) line in the inflation-output space. Put together, the IA-AD functions provided an alternative to the AS-AD model, in terms of the inflation rate instead of the price level. Finally, some extensions were also discussed; in particular, the analysis of the open economy was referred to a companion paper available online at the author's web page, where he presents a model with a monetary rule for both the closed and the open economy, but considering only the aggregate demand side for the latter. The first version of that paper, designed to accompany Mankiw's (2012) textbook (first edition published in 1992), dates from August 1999, and the most recent one from January 2012 (Romer, 2012). Similar points were also made by Taylor (2000) and Walsh (2002), but they did not deal with the case of the open economy.

Since then, some (but very few, and mostly European) Macroeconomics textbooks have incorporated a monetary policy rule instead of the LM function, together with an aggregate supply function derived from the Phillips curve; which implies that the AS-AD model is defined as a relationship between the level of output and the rate of inflation, instead of the price level. While this has resulted in a more realistic approach, the analysis has been mostly applied to the closed economy. And, when the open economy was introduced, its treatment has not been substantially different from the closed economy case, in particular regarding aggregate supply.

In this paper, we present a proposal of analysis of the open economy within a framework that incorporates a monetary policy rule instead of the LM function, extended to describe the case of a monetary union. The model comes from a recently published textbook (Bajo-Rubio and Díaz-Roldán, 2011b), aimed to teach Macroeconomics at an intermediate level. We begin by examining how the available Macroeconomics textbooks have dealt with the depiction of monetary policy from the determination of the interest rate through a rule followed by the central bank. Then, we turn to present in greater detail the main features of the approach followed along the book, in order to extend to an open economy framework the model with a monetary policy rule.

MONETARY POLICY RULES IN MACROECONOMICS TEXTBOOKS

As far as we know, the first textbook to introduce a macroeconomic model including a monetary policy rule instead of an LM function is Sørensen and Whitta-Jacobsen (2010) (first edition published in 2005). In general, their approach is similar to ours, with the supply side based on imperfect competition features, where workers set wages and firms set prices; and the model is developed for the open economy. Unlike us, however, the real exchange rate is not included in the aggregate supply, which implies that the aggregate supply function will be the same in the open economy and in the closed economy, except for the assumption that the expected value for the rate of inflation is the rate of inflation of the rest of the world; which, on the other hand, also equals the target inflation in the monetary rule.

In their ambitious textbook, Carlin and Soskice (2006) develop with a great detail a model with a monetary rule, but only for the case of a closed economy. However, the model for the open economy (Part Three, chapters 9 to 12) does not incorporate a monetary rule based on the control of inflation, simply assuming that the real interest rate equals that of the rest of the world. The model with a monetary rule for the closed economy of Part One is later developed for the open economy case in Carlin and Soskice (2010). The real exchange rate is included into the IS function, and a function for the real exchange rate similar to ours is obtained; however, the real exchange rate does not appear in the aggregate supply, which will be identical therefore to that of the closed economy. As an important difference of Carlin and Soskice's models with ours (see below), their monetary rule is obtained from the minimization by the central bank of a loss function that depends on the deviations of the level of output with respect to potential, and of the rate of inflation with respect to target. This assumption implies that, in the medium-run equilibrium, the inflation rate will always equal the target value set by the central bank.

In any event, notice that the textbooks by Sørensen and Whitta-Jacobsen and Carlin and Soskice are both of an advanced level and their coverage of topics is much wider than in our book, which is intended to provide a more compact and self-contained approach, and is aimed at an intermediate level of complexity.

Leaving aside Romer's (2012) above mentioned paper, the first textbook on intermediate Macroeconomics that incorporates a monetary policy rule instead of the LM function is Jones (2011) (first edition published in 2008). The style of this book is quite didactic, but the level is sometimes rather elementary for a textbook on intermediate Macroeconomics. For instance, the monetary rule does not depend on the level of output, but only on the difference between the current inflation rate and the target set by the central bank. On the other hand, although the foreign sector appears in the book's core devoted to the short run (Part 3, chapters 9 to 14), it is introduced in fact as an exogenous variable, so its role is indistinguishable from that of fiscal policy or the autonomous components of consumption and investment. The foreign sector as a separate component of aggregate demand (that is, with net exports as a function of the real exchange rate) is not truly introduced until chapter 19, at the end of the book; and the discussion is rather brief. Lastly, the real exchange rate does not appear in the aggregate supply, so that the aggregate supply function is the same for both the open and the closed economy.

Finally, we will mention the recently published sixth edition of Burda and Wyplosz (2013). Unlike previous editions of this textbook, the authors replace from the beginning the LM curve with a Taylor rule (from Taylor, 1993), termed TR. While their IS-TR model in Chapter 10 is roughly similar to our IS-MR model (see below), the AS-AD model presented in Chapter 13, designed directly for the open economy, is not fully worked out. In particular, the exchange rate

is not incorporated into the aggregate supply, and the analysis of supply shocks is simply sketched.

MAIN FEATURES OF OUR APPROACH

As mentioned above, the analysis of monetary policy in our book makes use of a monetary policy rule that replaces the traditional LM function. As is well known, the outbreak of financial innovation, through the development of many new financial assets with a high degree of liquidity but offering a return to their owners, means that the demand for money, and hence the LM function, become extremely unstable. Then, as already shown by Poole (1970), in such circumstances the desirable intermediate target for monetary policy should be the interest rate rather than money supply. On the other hand, although the interest rate controlled by the central bank is the nominal interest rate, it is the real interest rate who affects the goods market; but, assuming the expected inflation rate is given in the short run, the real interest rate will be controlled indirectly by the central bank.

Hence, monetary policy will be assumed to follow a rule, so that the interest rate will be changed by the central bank as a function of the difference between the current inflation rate and a target set by the monetary authority (i.e., following the so called inflation targeting), and of the evolution of the level of output. This implies that the function of the monetary rule (or MR function) describes an increasing relationship between the interest rate and the level of output, as the traditional LM function. Accordingly, the MR function, together with the traditional IS function, makes the IS-MR model, alternative to the IS-LM model.

Notice, on the other hand, that, unlike the approach of Carlin and Soskice (2006), our monetary rule does not derive from the optimization of the target function of the central bank, given the macroeconomic model describing the economy. We follow in turn the pragmatic proposal of McCallum (1988) of using a “robust” rule in the sense of providing reasonable results for a wide variety of models; in particular, our rule is derived from that suggested by Taylor (1993). This choice will imply that, as a result of any shock that is not transitory, the inflation rate will deviate from the target set by the central bank, assuming that in the starting situation both were equal.

Our analysis of the aggregate supply is based on imperfect competition assumptions, where wages are set through a bargaining process between workers and firms, and prices are then set by firms. Such a modeling of aggregate supply, widely used in the analysis of unemployment in the European economies, follows Layard, Nickell and Jackman (2005) (first edition published in 1991). That framework allows one to stress the role of institutional aspects in economic evolution, as well as to account for the presence of involuntary unemployment. In this way, from the wage and price equations, a Phillips curve is obtained; which, combined with a simple assumption of proportionality between the levels of output and employment (together with the definition of the unemployment rate), leads to the aggregate supply function. Then, joining this aggregate supply function with the aggregate demand function obtained from the IS and MR functions, we have the AS-AD model that now relates the level of output and the rate of inflation, instead of the price level. According to this approach, potential output is obtained in the medium run, once prices have fully adjusted and the inflation rate does not change as compared to the previous period; and the associated unemployment rate will be the NAIRU or non-accelerating inflation rate of unemployment.

Finally, our analysis of the open economy incorporates two main novelties. First, we start from the assumption that, in an open economy, workers are not concerned with the real wage in

terms of domestic prices, but with the real wage in terms of the consumption price index, i.e., that including the prices of imported goods. And this in turn implies that the aggregate supply function depends on the real exchange rate, in line with Sachs's (1980) pioneering contribution. As a consequence, in the medium run, neither potential output nor the NAIRU will be unique, but they will depend on the real exchange rate. Hence, and unlike the closed economy, the level of potential output could be changed due not only to supply shocks, but also in the presence of shocks to the domestic demand of goods, and external shocks; the only shocks unable to change the level of potential output are monetary shocks.

Second, when analyzing the open economy, we consider, together with the case of flexible exchange rate, a monetary union as an alternative to the case of fixed exchange rates. As is well known, in last years fixed exchange rate systems have revealed as extremely fragile and difficult to maintain. The ultimate reason would be the huge growth of international capital markets, which has resulted in a great vulnerability of the fixed exchange rate systems faced to speculative attacks in a massive scale. This problem is related with the "impossible trilogy" principle, that is, the impossibility of keeping simultaneously free capital movements, a fixed exchange rate, and an independent monetary policy. So, in a world characterized by an enormous international capital mobility, where many countries are reluctant to adopt a flexible exchange rate system (Calvo and Reinhart, 2002), the only alternative for a country would seem to be the formation of a monetary union, namely, the adoption of a common currency with other countries with which she has some special links.

Notice that a monetary union is somewhat of a particular case of a fixed exchange rate, since when a country joins a monetary union her national currency disappears, setting an irrevocable fixed exchange rate with regard to the new currency. In turn, the latter can be either a completely new currency (such as the euro), or other country's currency (such as the US dollar in some Latin American countries, or the euro in some Eastern European countries). Hence, in a world in which maintaining a fixed exchange rate system becomes increasingly difficult, the traditional alternative regarding the choice of the exchange rate system, between flexible exchange rates and fixed exchange rates, is more and more a choice between flexible exchange rates and a monetary union (Obstfeld and Rogoff, 1995).

In this way, we adapt the IS-MR and AS-AD models to the case of a monetary union, following the general framework proposed in Bajo-Rubio and Díaz-Roldán (2011a). We assume a monetary union made up of two identical countries, where each variable of the union is a weighted average of the corresponding variables of the member countries. A particular feature of these models is that, as long as monetary policy is performed by a central bank that is common to the two countries, such central bank is going to control the nominal interest rate common to both economies; however, the real interest rates will be different across countries, as long as inflation rates are different too. In addition, we will differentiate between common shocks, which occur simultaneously in the two countries belonging to the union, and country-specific shocks, which occur in just one of them. This differentiation is important since, in some particular circumstances, a country-specific shock will provoke opposite-sign effects in each country of the union; in other words, it will work as an asymmetric shock, namely, that requiring a different optimal policy response in every country that suffers the shock. The existence of asymmetric shocks has been pointed out as a potential impediment for the successful working of a monetary union, since the pioneering contribution of Mundell (1961).

In the next section, we sketch the AS-AD model for the open economy, for the case of a flexible exchange rate. The model for the monetary union will be presented in the following section.

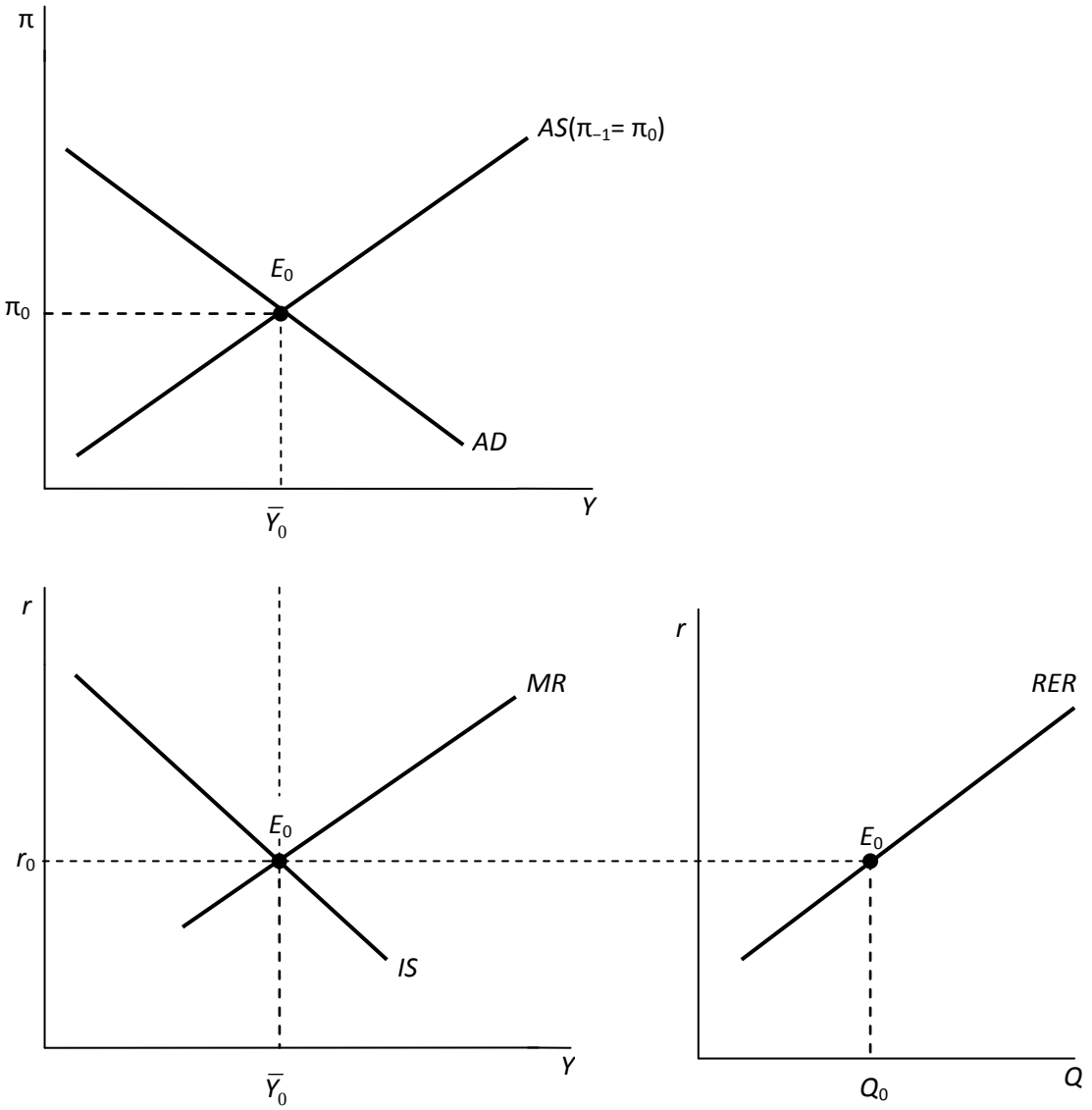
AN AS-AD MODEL FOR THE OPEN ECONOMY

We assume a standard IS function including net exports, which depend negatively on the real exchange rate. The real exchange rate is defined as the price of domestic goods in terms of foreign goods, so that an increase (decrease) means an appreciation (depreciation). In addition, the real exchange rate is assumed to depend positively on the differential between the domestic and foreign real interest rates, which gives an increasing relationship between the real interest rate and the real exchange rate, termed the RER schedule. We also have an MR function, where the real interest rate depends positively both on the difference between the inflation rate and the target set by the central bank, and on the level of output. And from the IS and MR functions, we get an AD function decreasing in the inflation-output space.

Regarding aggregate supply, we have a Phillips curve-type AS function that positively relates output and inflation, where inflation expectations are proxied by the inflation rate at the beginning of the period of analysis. In the specific case of the open economy, it is assumed that the wage set in the bargaining process does not depend on the domestic price level, but depends on the consumption price index, i.e., a weighted average of the prices of domestic and import goods; in other words, the real wage target is now defined in terms of the consumption price index instead of the domestic price level. Accordingly, the AS function will shift upwards (downwards) following a one-period lagged depreciation (appreciation) of the real exchange rate.

The AS-AD model for the open economy, with a flexible exchange rate, is shown in Figure 1. Here, r, Y, Q, and π denote the real interest rate, output, real exchange rate, and inflation rate, respectively. The medium-run equilibrium occurs at points E_0, where inflation is constant (i.e., $\pi_0 = \pi_{-1}$), so that output equals its potential level, denoted by $\bar{Y}$ (and the unemployment rate equals the NAIRU).

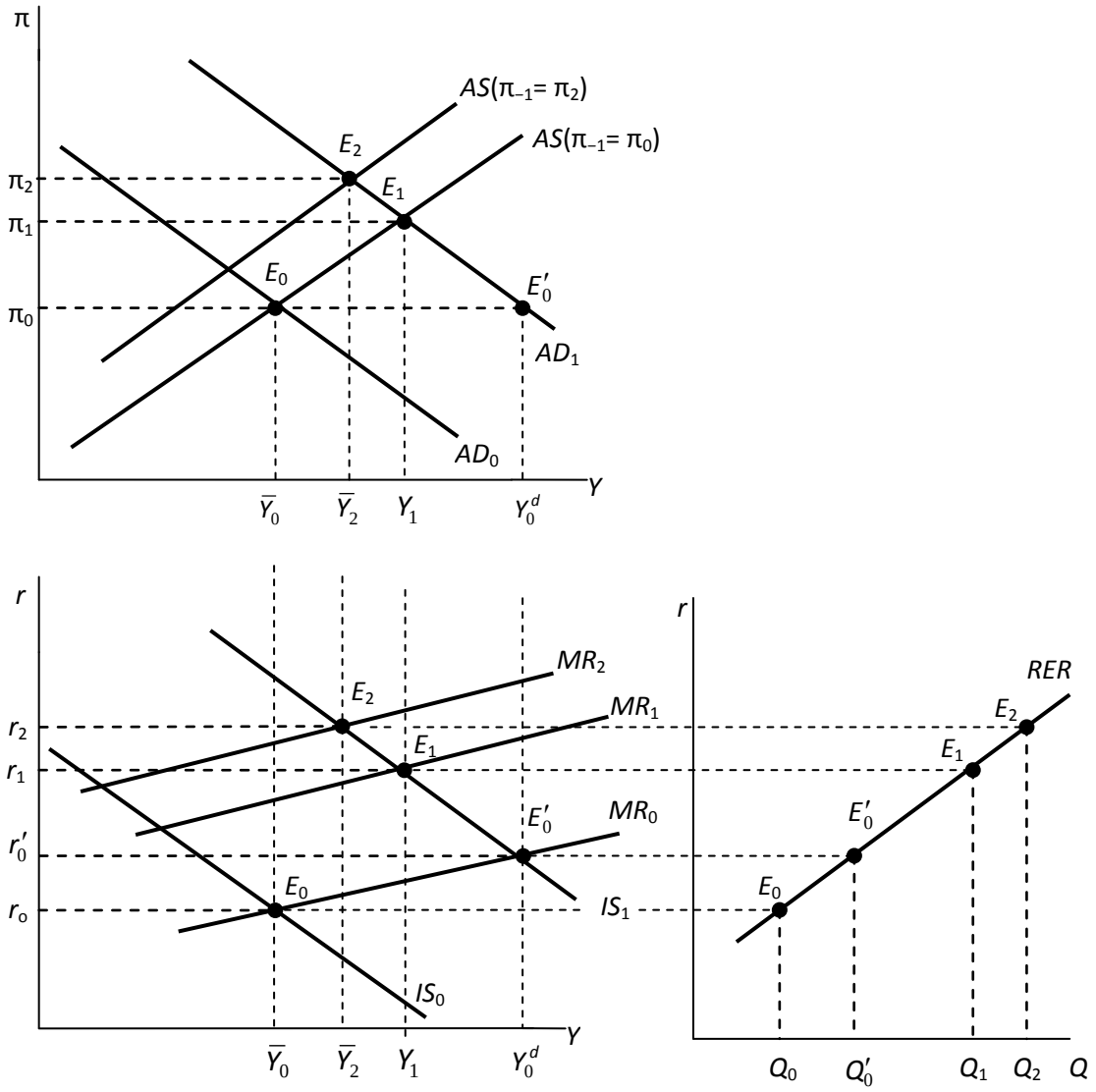
Figure 1
THE AS-AD MODEL FOR THE OPEN ECONOMY



The effects of an increase in government spending (or, in general, an increase in the domestic demand of goods, say, an increase in autonomous consumption or investment, or a tax cut) are shown in Figure 2. Starting from the medium-run equilibrium at points E_0, aggregate demand initially raises up to Y_0^d at points E_0' due to the higher government spending, amplified by the multiplier effect on consumption, and lowered by a decrease in investment (via a higher real interest rate through the monetary policy rule) and a worsening of the trade balance (via the multiplier effect on imports and an appreciation of the real exchange rate). Output increases

following the rise in aggregate demand, which raises the inflation rate (via higher wage claims), and this in turn leads to a fall in aggregate demand at points E_1, due to a new increase in the real interest rate through the monetary rule, and an additional real exchange rate appreciation. In the next period, the increase in domestic inflation would lead to higher wage claims, but the real exchange rate appreciation (by lowering import prices) would work in the opposite sense; we have assumed in Figure 2 that the first effect dominates so the AS function shifts upwards, leading to an additional increase in inflation. In the end, in the new medium-run equilibrium at points E_2 the level of potential output has risen, as well as the real interest rate and the domestic inflation rate, although the effect on the latter variable would be strictly ambiguous. Therefore, unlike the closed economy, in the new medium-run equilibrium potential output would be higher (and the NAIRU lower), since the real exchange rate appreciation tends to offset the effects on wage claims of the higher domestic inflation.

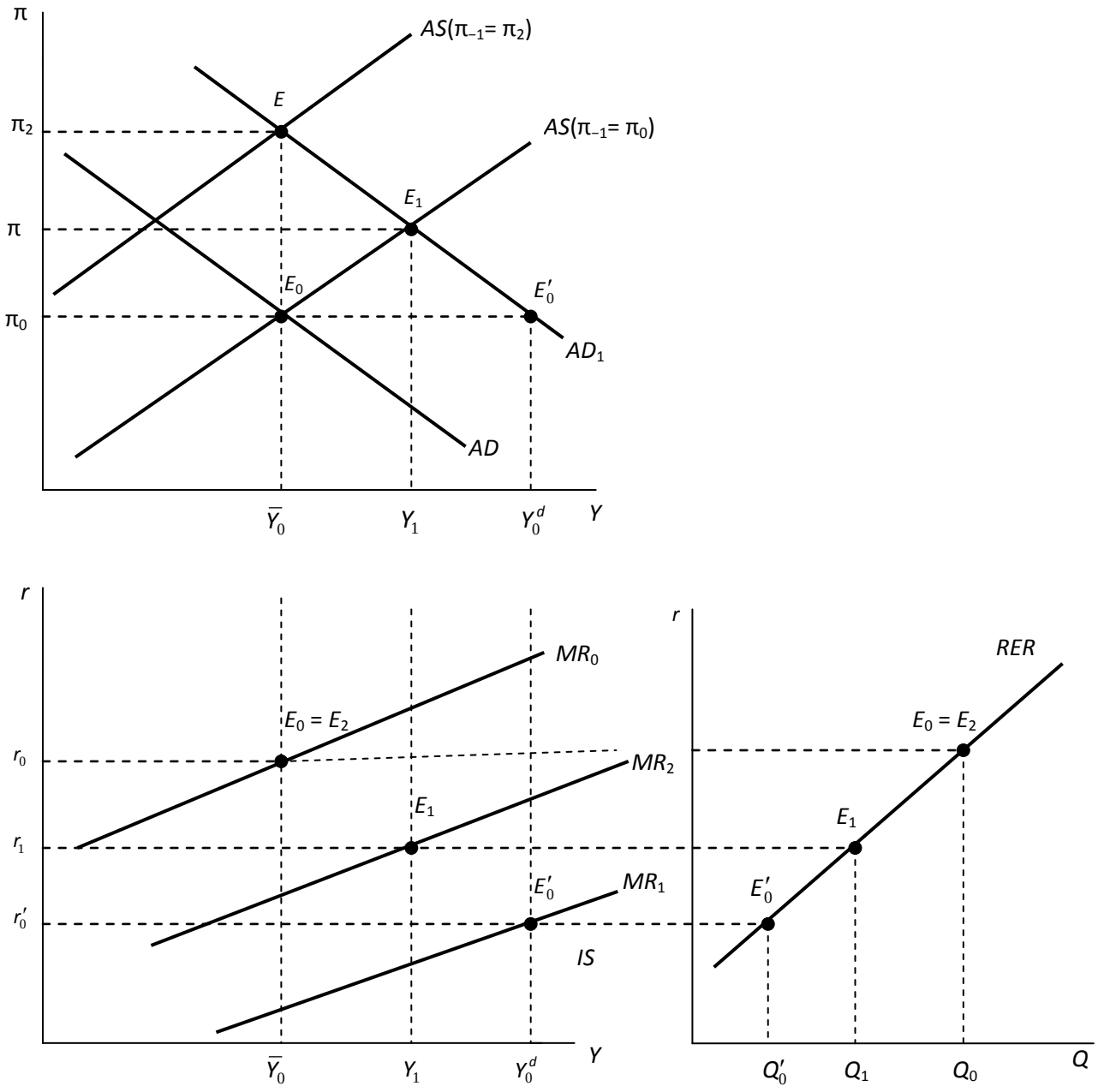
Figure 2
AN INCREASE IN GOVERNMENT SPENDING IN THE AS-AD MODEL FOR THE OPEN ECONOMY



The case of an expansionary monetary policy, through an increase in the inflation target set by the central bank, is depicted in Figure 3. Starting again from the medium-run equilibrium at points E_0, the real interest rate falls; and this raises aggregate demand up to Y_0^d at points E_0',

due to an increased investment and an improved trade balance in response to the depreciation of the real exchange rate. As in Figure 2, output increases, raising the inflation rate (via higher wage claims), which decreases aggregate demand due to the increase in the real interest rate through the monetary rule, and a partial real exchange rate appreciation, reaching points E_1. Next, in the following period both the increase in domestic inflation and the real exchange rate depreciation (by raising import prices) would lead to higher wage claims, so that the domestic inflation rate increases even more, the central bank raises again the real interest rate, and the real exchange rates appreciates. Therefore, in the final medium-run equilibrium at points E_2 potential output (and the NAIRU), the real interest rate and the inflation rate return to their initial levels, and the domestic inflation rate increases in the same proportion than the central bank's inflation target. That is, unlike the fiscal policy case shown in Figure 2, the final new medium-run equilibrium does not change as compared to the closed economy case; and the ultimate reason is that the real exchange rate is kept unchanged since the nominal exchange rate depreciates in the same proportion than the increase in domestic prices.

Figure 3
AN INCREASE IN THE INFLATION TARGET IN THE AS-AD MODEL FOR THE OPEN ECONOMY



The above model can be used to show the effects of other shocks, such as external shocks (either to the trade balance, or the foreign interest rate) or supply shocks. In particular, for the latter case, it can be shown that a positive supply shock (i.e., one reducing the inflation rate at the initial level of output) raises potential output (and reduces the NAIRU) in the medium run, which

is accompanied with a lower domestic inflation and real interest rate, together with a real exchange rate depreciation; see Bajo-Rubio and Díaz-Roldán (2011b).

THE MODEL FOR A MONETARY UNION

The AS-AD model for the open economy with flexible exchange rates assumed that the economy analyzed was small, which implied that the variables from the rest of the world were exogenous. Now we will assume, on the contrary, that the two countries in our simplified world (i.e., the country under study and the rest of the world) make a monetary union, which means that the two countries decide to abolish their national currencies and adopt a currency common to both of them. The two countries are assumed to be identical, and each variable of the union is a weighted average, being the weights equal to $\frac{1}{2}$, of the corresponding variables of the two countries. Accordingly, the variables from the rest of the world will be now endogenous and, on the other hand, the assumption of a two-country world will imply that the monetary union as a whole is a closed economy.

In this way, each country will have an IS and an MR function, which make up the IS-MR model for the monetary union; notice here that, although the nominal interest rate is common for the two economies, the real interest rates will be different across them as long as the inflation rates are different too. As before, from the IS and MR functions we get the AD function for each country that, coupled with the corresponding AS functions, make up the AS-AD model for the monetary union. Again, and for the sake of comparison with the previous section, we will also focus on this AS-AD model.

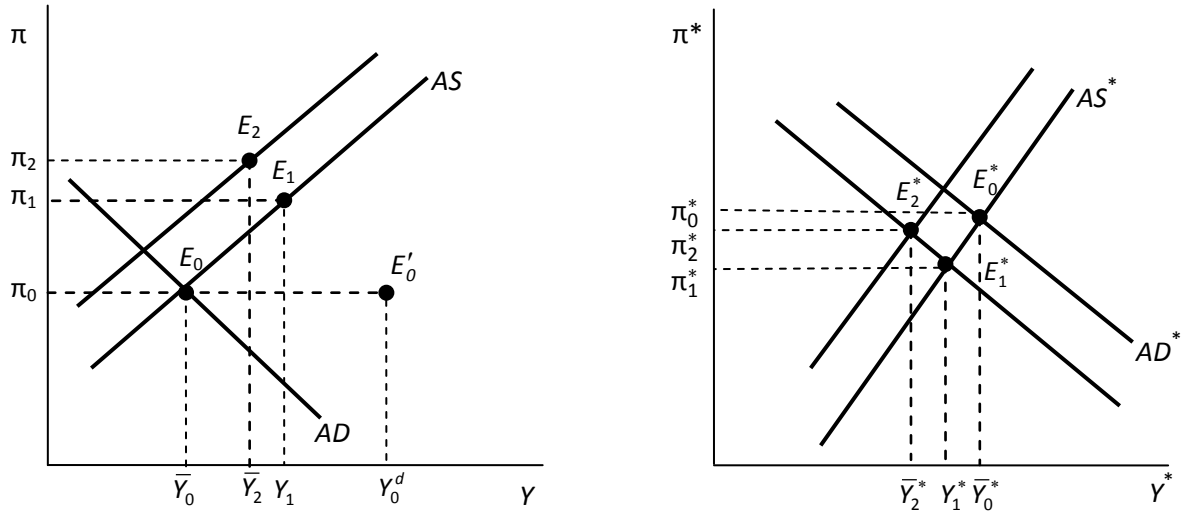
Regarding the occurrence of shocks, our framework allows to differentiate between common shocks, which occur simultaneously in the two countries belonging to the union, and country-specific shocks, which occur in just one of them. Given our assumption of a monetary union made up of two identical countries, with weights equal to $\frac{1}{2}$, the effects of a common shock will be the same in each member country and in the whole union; and these effects, in turn, will equal those resulting in the closed economy case. As for the effects of a country-specific shock, they will be the same for the union as a whole as in the model of the closed economy; and will equal the weighted sum, with weights equal to $\frac{1}{2}$, of the effects on each member country. The distribution of these effects across the two countries will not be uniform, however. So, for the country of origin of the shock the sign of the effects will be the same than in the union as a whole, but this will not be necessarily true for the other member country to which the shock is transmitted. Indeed, the effects of a country-specific shock will be quantitatively greater, in absolute terms, for the country of origin of the shock, both regarding the other country and the union as a whole.

Since the effects of a common shock, on each country and the whole union, are standard, and equal to those occurring in the closed economy, in the rest of this section we will only analyze the effects of country-specific shocks. In particular, we will examine the case of two country-specific shocks: on the domestic demand of goods, and on the aggregate supply; notice that in this framework monetary shocks are always common.

The effects of a country-specific increase in government spending in the AS-AD model for a monetary union, are depicted in Figure 4. The figure shows the AS and AD functions for the two member countries of the monetary union, and we assume that the shock occurs in the first country (the results would be symmetrical if the increase in government spending would had

happened in the other country); the variables of the second country are denoted by a star. Starting from a medium-run equilibrium at points E_0 and E_0^* for each country, aggregate demand initially increases in the first country up to Y_0^d at point E_0' due to the higher government spending, amplified by the multiplier effect on consumption, and lowered by a decrease in investment (via a higher real interest rate through the monetary policy rule). Following the rise in aggregate demand, output increases and so the inflation rate (via higher wage claims), which leads to a fall in aggregate demand due to the increase in the real interest rate through the monetary rule; so, output reaches Y_1, above potential, at point E_1.

Figure 4
A COUNTRY-SPECIFIC INCREASE IN GOVERNMENT SPENDING IN THE AS-AD MODEL FOR A MONETARY UNION

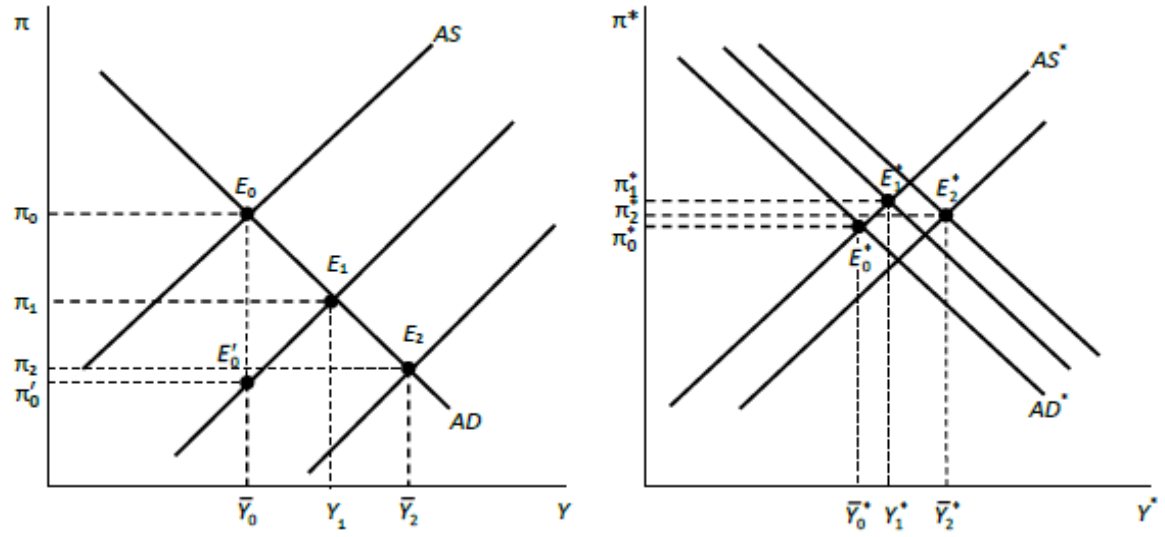


As for the second country, the higher level of output in the first country leads to two opposite effects: (i) a contractionary effect due to the increase in the interest rate by the central bank of the union; and (ii) an expansionary effect due to the higher income level in the first country that raises the second country's exports. The net effect is therefore ambiguous; we have assumed in Figure 4 that the first one prevails so the level of output in the second country falls up to Y_1^*, below potential, at point E_1^*.

Notice that the union's inflation rate will be higher, since the increase in the first country is greater than the fall in the second. Accordingly, via higher wage claims, inflation rate in both countries will tend to rise as the AS and AS^* functions shift upwards. In the end, compared with the initial equilibrium, in the new medium-run equilibrium at points E_2 and E_2^* potential output is higher in the first country and lower in the second; and inflation rates increase and decrease (although in the latter case, the sign of the effect would be generally ambiguous), respectively. Notice, however, that the rise in potential output in the first country from $\overline{Y}_0$ to $\overline{Y}_2$ in the first country, and the fall in the second from $\overline{Y}_0^*$ to $\overline{Y}_2^*$, offset exactly, so that potential output in the union as a whole will be unchanged.

Finally, we show in Figure 5 the effects of a country-specific aggregate supply shock that lowers the inflation rate at the initial level of potential output, in the AS-AD model for a monetary union, where we assume again that the shock occurs in the first country. Starting from a medium-run equilibrium at points E_0 and E_0^* for each country, the inflation rate falls in the first country up to π_0' at point E_0', which leads to a higher level of output (via a lower real interest rate through the monetary policy rule) at point E_1. In the second country, the lower real interest rate has an expansionary effect on output, and the same happens with the higher output level in the first country, even though the latter effect would lead the central bank to raise the real interest rate. Assuming that the expansionary effect prevails, the AD^* function shifts rightwards and output rises in the second country too, at point E_1^*. The overall effect on the union, on the other hand, would be a higher output and a lower inflation rate.

Figure 5
A COUNTRY-SPECIFIC AGGREGATE SUPPLY SHOCK THAT LOWERS THE INFLATION RATE IN THE AS-AD MODEL FOR A MONETARY UNION



In the following period, the lower inflation rate in the first country leads the AS and AS^* functions to shift downwards, via lower wage claims; and the central bank will reduce again the real interest rate in response to the lower inflation, which raises aggregate demand and output. In the new medium-run equilibrium at points E_2 and E_2^* potential output is higher in both countries; and the inflation rate is lower and slightly higher, respectively, although the sign of the effect on inflation for the second country would be generally ambiguous. Again, in the final equilibrium potential output rises and inflation falls in the union as a whole.

CONCLUDING REMARKS

In this paper, we have presented a novel framework for macroeconomic analysis, which tries to incorporate recent theoretical developments into a model describing an open economy, and should be useful for teaching purposes. The main features of our approach are as follows:

1. *First, monetary policy is assumed to follow a rule, so that the interest rate is set by the central bank as a function of the difference between the current inflation rate and a target set by the monetary authority, and of the evolution of the level of output. This implies that the function of the monetary rule (or MR function) describes an increasing relationship between the interest rate and the level of output, as the traditional LM function. Accordingly, the MR function, together with the traditional IS function, makes the IS-MR model, alternative to the IS-LM model.*
2. *Second, our analysis of the aggregate supply is based on imperfect competition assumptions, where wages are set through a bargaining process between workers and firms, and prices are then set by firms. In this way, from the wage and price equations, a Phillips curve is obtained; which leads to the aggregate supply function. Then, joining this aggregate supply function with the aggregate demand function obtained from the IS and MR functions, we have the AS-AD model that now relates the level of output and the rate of inflation, instead of the price level.*
3. *Third, regarding the case of the open economy, we assume that workers are not concerned with the real wage in terms of domestic prices, but with the real wage in terms of the consumption price index, i.e., that including the prices of imported goods. This in turn implies that the aggregate supply function depends on the real exchange rate. Hence, and unlike the closed economy, the level of potential output could be changed due not only to supply shocks, but also in the presence of shocks to the domestic demand of goods, and external shocks; with monetary shocks being the only ones unable to change potential output.*

Finally, and as a novelty compared with the available textbooks, we adapt the IS-MR and AS-AD models to the case of a monetary union. Notice that a monetary union can be considered as a particular case of a fixed exchange rate, and an alternative to the latter in a world characterized by a huge degree of international capital mobility. Accordingly, when analyzing the open economy we consider, together with the case of flexible exchange rates, the case of a monetary union instead of fixed exchange rates.

REFERENCES

Bajo-Rubio O & C Díaz-Roldán (2011a) *Macroeconomic analysis of monetary unions: A general framework based on the Mundell-Fleming model*. Berlin: Springer-Verlag.

Bajo-Rubio O & C Díaz-Roldán (2011b) *Teoría y política macroeconómica*. Barcelona: Antoni Bosch editor.

Burda M & C Wyplosz (2013) *Macroeconomics: A European Text (Sixth Edition)*. Oxford: Oxford University Press.

Calvo GA & CM Reinhart (2002) Fear of floating. *Quarterly Journal of Economics*, *117*(2),379-408.

Carlin W & D Soskice (2006) *Macroeconomics: Imperfections, Institutions, and Policies*. Oxford: Oxford University Press.

Carlin W & D Soskice (2010) A New Keynesian open economy model for policy analysis. Discussion Paper 7979, London: Centre for Economic Policy Research.

Galí J (2008) *Monetary Policy, Inflation and the Business Cycle: An Introduction to the New Keynesian Framework*. Princeton, NJ: Princeton University Press.

Jones CI (2011) *Macroeconomics (Second Edition)*. New York, NY: W. W. Norton.

Layard R, S Nickell & R Jackman (2005) *Unemployment: Macroeconomic performance and the labour market (Second Edition)*. Oxford: Oxford University Press.

Mankiw NG (2012) *Macroeconomics (Eighth Edition)*. New York, NY: Worth Publishers.

McCallum BT (1988) Robustness properties of a rule for monetary policy. *Carnegie-Rochester Conference Series on Public Policy*, *29*(1), 173-203.

Mundell R.A (1961) A theory of optimum currency areas. *American Economic Review*, *51*(4),657-665.

Obstfeld M & K Rogoff (1995) The mirage of fixed exchange rates. *Journal of Economic Perspectives*, *9*(4),73-96.

Poole, W. (1970). Optimal choice of monetary policy instruments in a simple stochastic macro model. *Quarterly Journal of Economics*, *84*(2), 197-216.

Romer D (2000) Keynesian macroeconomics without the LM curve. *Journal of Economic Perspectives*, *14*(2),149-169.

Romer D (2012)Short-run fluctuations. Retrieved June 7, 2016, from http://emlab.berkeley.edu/~dromer/papers/Romer%20Short-Run%20Fluctuations%20January%202012.pdf.

Sachs J (1980) Wages, flexible exchange rates, and macroeconomic policy. *Quarterly Journal of Economics*, *94*(4), 731-747.

Sørensen PB & HJ Whitta-Jacobsen (2010) *Introducing Advanced Macroeconomics: Growth and Business Cycles (Second Edition)*. New York, NY: McGraw-Hill.

Taylor JB (1993) Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, *39*(1),195-214.

Taylor JB (2000) Teaching modern macroeconomics at the principles level. *American Economic Review*, *90*(2),90-94.

Walsh C (2002) "Teaching inflation targeting: An analysis for intermediate macro", *Journal of Economic Education*, *33*(4),333-346.

CONDITIONS ASSOCIATED WITH ADOLESCENTS' HAPPINESS IN OECD COUNTRIES

Young-Chool Choi, Chungbuk National University
Ji-Hyun Jang, Sangmyung University

Abstract

This study was conducted in order to discover the combinations of conditions associated with adolescents' happiness, which is crucial to enhancing national happiness in every country, and to put forward policy suggestions whereby each country may raise the level of its adolescents' happiness.

The HSBC (Health Behavior in school-aged Children Survey) score of adolescents from 22 OECD countries was selected as an indicator for happiness, and some independent variables such as per capita GDP and ratio of students to teaching staff were included in the analysis. We employed the QCA (Qualitative Comparative Analysis) method to analyze the complex causal relationships among the factors affecting adolescents' happiness. The research results show that there are four significant combinations of variables affecting adolescents' happiness (HBSC score). Model 1 is a configuration of three variables (low total per capita expenditure on education, low per capita GDP, low level of meeting the needs of a competitive economy), and includes United Kingdom and Portugal Model 2 is a configuration of three variables (low total per capita expenditure on education, low level of meeting the needs of a competitive economy, low ratio of students to teaching staff, and includes Austria, Portugal, and United States. Model 3 is a configuration of four variables (high total per capita expenditure on education, high per capita GDP, high ratio of students to teaching staff, and high total expenditure on education as a percentage of GDP), and includes Switzerland and Norway. Model 4 is a configuration of four variables (low total expenditure on education as a percentage of GDP, low total per capita expenditure on education, high per capita GDP, high level of meeting the needs of a competitive economy), and includes Netherlands, Ireland, France, and Germany. Finally, the study suggests that each country should endeavor to enhance its own adolescents' happiness, considering how the factors associated with this relate to each other.

Keywords: *adolescent's happiness, conditions for adolescent's happiness, educational condition, Korea*

INTRODUCTION

Numerous efforts have been made to define and redefine the concept of adolescents' happiness in the context of adolescent indicators. Much of this effort is rooted in Western culture in developed countries. Recently, in particular, in the social science academia there have been active researches on happiness, and especially studies on the happiness of children-adolescents are gathering a wide range of interest. Studies on the happiness of adolescent that were initiated in a worldwide scale by international organizations such as the United Nations Children's Fund(UNICEF) and further accelerated following the enactment of the UN Convention of the Rights of the Child in 1989. Also the children-adolescent happiness index was recognized of its

importance as a basis for confirming policy objectives and inspecting accomplishments, and accordingly many researchers and organizations around the globe are conducting similar studies at present.(Ben-Arieh, 2006; Choi, 2015). An increase in such studies on children or adolescent groups reflect the rising international interest of happiness. Especially according to recent studies the happiness during one's early stages of life also influences one's overall happiness even after he or she becomes an adult(Yang, 2008), and so its importance is even further emphasized.

In this context a UNICEF study conducted in 2006 organized the children-adolescent happiness index into 6 categories: 'Material Well-Being', 'Health and Safety', 'Education', 'Peer and Family Relationship', 'Subjective Well-Being', and 'Behaviour and Risk'. This study then reorganized these categories into 18 components and 40 indicators in order to measure happiness. In specific, the 'Material Well-Being' section was formed of relative poverty, unemployed households, deficiency, the 'Health and Safety' section was of infant health, vaccination and accidental deaths, and the 'Education' section was of scholastic achievement, education participation and the changeover to employment. The 'Peer and Family Relationship' section was formed of family structures, parent relationships and peer relationships, the 'Subjective Well-Being' section was of health, school life and individual happiness, and the 'Behaviour and Risk' section was of health behaviour, risk behaviour and violence experiences. Therefore the children-adolescent happiness is based on a multifaceted index that can reflect its relational complexity with life(Park Jong-Il, Park Chang-Woong, Seo Hyo-Jeong, Yeom Yoo-Shik, 2010; UNICEF, 2006).

As was seen, UNICEF(2006) thought it appropriate to take a multifaceted approach towards the happiness of adolescents and endeavored to measure it. However even out of these measuring indexes the 'Education' section is a crucial factor in that the main developmental task of an adolescent is one's school learning and that the educational environment one is exposed to can determine his or her happiness, well-being and even future.(UNICEF, 2006). Considering this, a more specific and integrated approach is required to understand the happiness of adolescents. Nevertheless the education section covered by UNICEF is only formed of scholastic achievement, education participation and the changeover to employment. This only covers a narrow range and thus can only reflect a limited amount of the environmental characteristics of the education of adolescents.

As a response, this study recognizes the need for research and will reorganize the educational factors that influence the happiness of adolescents into the percentage of educational expenses(the percentage of educational expenditure out of the per capita GDP), the per capita educational expenditure amount, ratio of students to teaching staff, educational decentralization level, school life satisfaction level, and the academic maintenance percentage. The goal of this study is to clarify the structural relationship between these variables and happiness, and to discover combinations of conditions affecting happiness of adolescents.

THEORETICAL BACKGROUND AND RESEARCH QUESTION

The happiness of adolescents

Discussion on the children-adolescent happiness index originates from the Social Indicators Movement in the 1960s(Aborn, 1985). There was a plethora of studies conducted by various academic circles on social indicators during the late 1960s and early 1970s, and it was during this period which led to the introduction of various conceptual approaches towards the development of the children-adolescent happiness index(Lippman, 2007). Furthermore, the State

of the World's Children report which has been published annually since 1979 by UNICEF and the UN Convention on the Rights of the Child adopted in 1989 led to an increase in international interest and researches. Happiness is used along with terms such as well-being, satisfaction in life, subjective well-being, quality of life and so on, and its definition is used slightly differently between scholars. Kim Shin-Young and Baek Hye-Jeong(2008) conceptualized the relationship the words used similarly with happiness, and stated that "happiness is the narrowest term in that it describes one's positive emotion to his or her life, subjective well-being is medium-sized term in that it is an accumulation of subjective evaluations of one's quality of life, and the subjective quality of life is the most comprehensive term in that different factors other than psychological ones such as subjective well-being can be included." Hereupon, in the following study happiness will be understood in its narrowest concept and will be defined as 'the feeling in which sufficient satisfaction and happiness is experienced in life(The National Institute of the Korean Language, 2014)'.

Related to such measurements on abstract happiness, many researchers have put their efforts in order to conduct an objective measurement. For instance, single questions such as 'How happy are you?', 'How satisfied are you with your life in overall?'(Campbell, Converse, & Rodgers, 1976), a facial measurement method which measures one's emotional state through facial expressions(Andrews & Withey, 1976), a happiness scale formed of two questions, 'In general how many times do you feel happy or unhappy emotions?' and 'In average how much in percentages did you feel happy'(Fordyce, 1988), a subjective happiness scale consisting of four questions and four options, 'Am I a happy person', 'Am I happy compared to my peers', 'Do I resemble one who does or does not pursue happiness and enjoy life′(Lyubomirsky & Rose, 1997), a subjective well-being scale which measures both positive and negative emotions towards satisfaction of life(Diener, 1984), a psychological well-being scale comprising of 46 questions(Ryff, 1998), and the Oxford happiness scale(Argyle, Martin, & Crossland, 1989) are frequently used, and there is also the well-being scale which adds social well-being to its criterion(Keyes, 2005).

In this study happiness is defined as a feeling in which sufficient satisfaction and joy is felt, and so supports Diener(1984)'s opinion which states that happiness should be evaluated based on one's subjective experience. Therefore out of the instruments used to conduct investigations on OECD 22 countries' adolescents, the questions of whether one is satisfied with his or her life mentioned in HBSC(Health Behavior in school-aged Children Survey, 2012) was thought to be closest to fulfilling the requirements needed to measure such concepts and happiness and thus was employed.

Factors affecting adolescents' happiness

It is generally understood that many factors can be involved in happiness or well-being in one country. Here, we address the potential factors associated with happiness of adolescents and their interrelationships.

First, we hypothesize that per capita GDP is associated with total expenditure on education. In OECD member countries, the proportion of total expenditure on education as a percentage of GDP is relatively high, accounting for approximately 5.6 percent of GDP in 2014. The proportion of expenditure on primary and secondary education is 3.7 percent of GDP, whereas that of expenditure on higher education is 1.4 percent of GDP (OECD, 2010). In spite of the fact that expenditure on education nowadays accounts for a large proportion of GDP, and

also has been increasing constantly, there have been few studies proving that growth in education spending leads to growth in adolescents happiness. In the meantime, some studies (Choi, 2008; Shin and Joo, 2013) have concluded that accumulated per capita expenditure on education has positively affected happiness of people. On the basis of these research findings, this study hypothesizes that per capita GDP, total expenditure on education, and total per capita expenditure on education affect adolescents' happiness.

Second, we hypothesize that pupil–teacher ratio can affect adolescents' happiness. The ratio of students to teaching staff is an important issue as regards the quality of education worldwide. It is assumed that the smaller the number of students a teacher can teach, the greater will be the adolescents' happiness. Third, we also hypothesize that education system can affect adolescents' happiness. In other words, whether education system of a country is primarily related to the system which seeks to meet the needs of a competitive economy, or not is important in terms of adolescents's happiness.

In summary, we include per capita GDP, total expenditure on education as a percentage of GDP, total per capita expenditure on education, ratio of students to teaching staff, and level of meeting the needs of a competitive economy as independent variables affecting the dependent variable, adolescents' happiness.

Research questions

On the basis of the theoretical discussion above, we suggest the following research question:

What are the combinations of variables associated with adolescents' happiness as a dependent variable?

RESEARCH DESIGN

Variables

The countries to be included in this analysis are OECD member countries. Among 34 OECD countries, twelve countries including Mexico and New Zealand, are excluded because of problems with data. The variables analyzed in this research consist of five independent variables and one dependent variable. The five independent variables are: per capita GDP, total expenditure on education as a percentage of GDP, total per capita expenditure on education, ratio of students to teaching staff, and level of meeting the needs of a competitive economy. The one final dependent variable is adolescents' happiness. Table 1 explains the names of the variables, their measurement, and their data source.

Table 1
VARIABLES AND DATA SOURCE

Variable name	*Measurement*	*Data source*	*Variable abbreviation*	*Remarks*
Adolescents' happiness	subjective recognition whether satisfied by one's life	HBSC(Health Behavior in school-aged Children Survey, 2012)	*happy*	
Per capita GDP	Per capita GDP	IMD, *World Competitiveness Yearbook* (2014)	*gdp*	
Total expenditure on education	Total expenditure on education as a percentage of GDP	IMD, *World Competitiveness Yearbook* (2014)	*tee*	
Total per capita expenditure on education	Total per capita expenditure on education	IMD, *World Competitiveness Yearbook* (2014)	*tepc*	
Pupil–teacher ratio	Ratio of students to teaching staff	OECD, *Education at a Glance* (2014)	*puptea*	Average score of two pupil–teacher ratios: primary and secondary school (latent variable in this model).
Education system	Level of education system in meeting the needs of a competitive economy	IMD, *World Competitiveness Yearbook* (2014)	*edusys*	

Analysis method

In this study, we employ Qualitative Comparative Analysis (QCA) method to discover conditions explaining adolescents' happiness in OECD countries. QCA as a method is founded on the binary logic of Boolean algebra. Each case included in the analysis is represented as a combination of causal and outcome conditions. Vink and Van Vliet (2009) describe QCA as a family of comparative techniques that aim to explain macro-social phenomena in a parsimonious way while working with small-to medium-size data sets. Rihoux (2006) suggests that small studies ($n<30$) are most suited to dealing with dichotomous subjects (few conditions), where a particular focus can be directed to individual cases. As Wagemann and Schneider (2010) states, no method is per se superior. Rather, its usefulness is determined by its fit to the research

problem at hand. In this regard, QCA is considered as a good tool to discover conditions affecting happiness of adolescents in 22 OECD countries.

The first stage in a QCA, like other methods is to show descriptive statistics included in the analysis. Then, it is necessary to standardize the original values of each variable in order to minimize the subjectivity occurring in the analysis process. The next stage is to build a truth table with data for selected cases regarding the causal conditions and the outcome variables. Truth tables list the logically possible combinations of conditions and the outcome associated with each combination (Poveda, 2013). Next, investigation of a truth table by itself allows for a study of diversity, showing which configurations are common and which ones do not happen or happen very seldom. In this process, Venn diagrams helps us understand the logical relationships between conditions. Finally, conditions explaining adolescents' happiness are derived, and prime implicants are suggested.

RESEARCH RESULTS

Descriptive statistics

Table 2 presents descriptive statistics for the constructs analyzed in our study, including means, standard deviations, and the minimum and maximum of the variables contained in the final sample of 22 OECD countries.

Table 2
DESCRIPTIVE STATISTICS

	N	Min.	Max.	Mean	S.D.
tee (%)	22	4.10	8.30	5.75	1.16
tepc (US dollar)	22	717	5437.0	2425.45	1285.59
gdp (US dollar)	22	13540	97255	42861.22	20239.23
edusys (scale)	22	4.08	8.64	6.36	1.27
puptea (no of students)	22	8.75	19.26	12.51	2.85
happy(score)	22	72.54	117.23	100.28	10.13

Table 3 shows statistics of variables of 22 OECD countries included in the analysis.

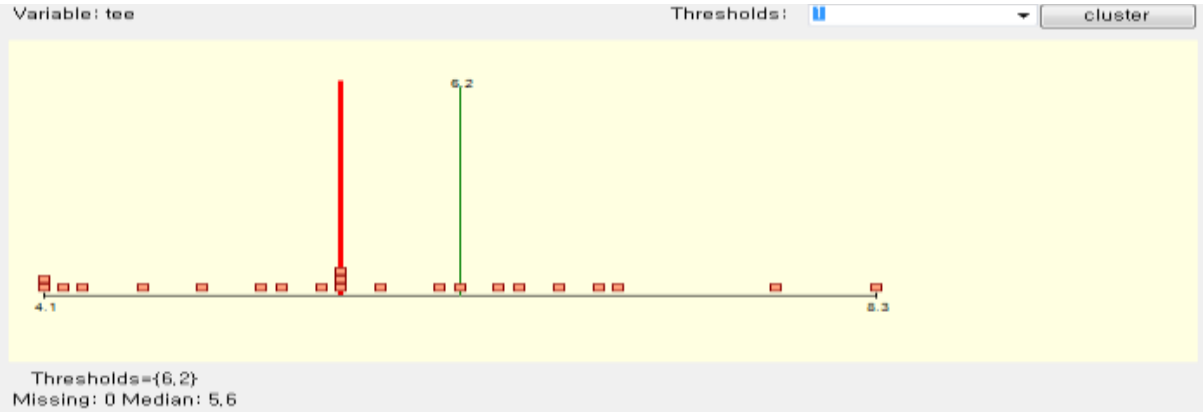
Table 3
STATISTICS OF VARIABLES

	tee	tepc	gdp	edusys	puptea	happy
Korea	4.6	785	22778	5.71	19.26	72.54
Switzerl	5.2	3643	81161	8.43	13.15	106.26
Netherla	5.8	2892	50355	7.24	14.72	114.2
Finland	6.4	3119	49350	8.64	13.86	102.21
Poland	5.3	718	13540	7.16	11.15	85.89
Belgium	6.2	2686	46878	7.69	10.27	85.65
Germany	4.3	1887	43742	7.32	12.8	101.98
Austria	5.6	2761	49809	6.05	10.32	105.58
Ireland	5.5	2712	47513	7.22	15.1	103.92
Denmark	7.8	4682	59928	7.83	11.5	94.79
Czech Re	4.1	839	20444	5.15	15.2	101.51
France	6.1	2657	44008	6.45	15.23	101.77
United K	6.9	2532	35592	6.07	17.9	97.11
Iceland	8.3	3294	43088	6.53	8.75	97.79
Norway	5.6	5437	97255	6.57	10.1	100.31
Portugal	6.5	1388	22413	5.14	9.2	100.53
Italy	4.2	1542	36267	4.85	11.65	107.32
Spain	4.9	1539	32360	4.53	11.6	117.23
United S	6.7	3052	48387	6.18	13.68	104.48
Sweden	7	3432	56956	6.66	9.63	104.76
Hungary	5.6	717	14050	4.08	11.2	88.69
Greece	4.1	1046	27073	4.61	9.08	111.76

Dichotomization and truth tables

Table 4 below shows dichotomized value, 0 or 1 of each variable in OECD countries. To dichotomize original values of each variable into 0 and 1, the calibration function contained in the TOSMANA software program was utilized. Figure 1shows how the original value of variable tee is dichotomized into 1 and 0. As is seen in Figure 1, the value higher than threshold 6.2 of variable tee is recorded into 1 whereas the value lower than the threshold is recorded into 0.

Figure 1
THRESHOLD OF VARIABLE TEE



With values of [0] and [1] assigned to study conditions, OECD countries can then be recorded, resulting in a truth table (Table 5).

Table 4
DICHOTOMIZED VARIABLES

	tee_1	tepc_1	gdp_1	edusys_1	puptea_1	happy_1
Korea	0	0	0	0	1	0
Switzerl	0	1	1	1	0	1
Netherla	0	0	1	1	1	1
Finland	1	1	1	1	0	1
Poland	0	0	0	1	0	0
Belgium	1	0	1	1	0	0
Germany	0	0	1	1	0	1
Austria	0	0	1	0	0	1
Ireland	0	0	1	1	1	1
Denmark	1	1	1	1	0	0
Czech Re	0	0	0	0	1	1
France	0	0	1	1	1	1
United K	1	0	0	0	1	1
Iceland	1	1	1	1	0	1
Norway	0	1	1	1	0	1
Portugal	1	0	0	0	0	1
Italy	0	0	0	0	0	1
Spain	0	0	0	0	0	1
United S	1	0	1	0	0	1

Sweden	1	1	1	1	0	1
Hungary	0	0	0	0	0	0
Greece	0	0	0	0	0	1

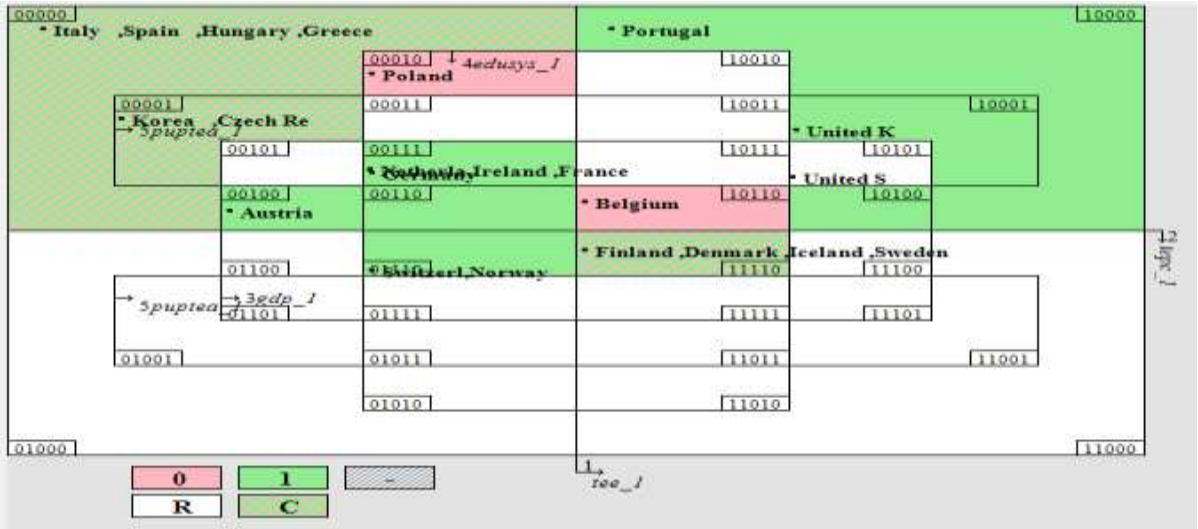
Table 5 shows the output for the most parsimonious solution for the adolescents' happiness in this analysis.

Table 5
TRUTH TABLE ANALYSIS

v1:	tee_1	v2:	tepc_1			
v3:	gdp_1	v4:	edusys_1			
v5:	puptea_1					
O:	happy_1	id:	Column1			
v1	v2	v3	v4	v5	O	id
0	0	0	0	1	C	Korea, Czech Re
0	1	1	1	0	1	Switzerl, Norway
0	0	1	1	1	1	Netherla, Ireland , France
1	1	1	1	0	C	Finland, Denmark, Iceland, Sweden
0	0	0	1	0	0	Poland
1	0	1	1	0	0	Belgium
0	0	1	1	0	1	Germany
0	0	1	0	0	1	Austria
1	0	0	0	1	1	United K
1	0	0	0	0	1	Portugal
0	0	0	0	0	C	Italy, Spain, Hungary, Greece
1	0	1	0	0	1	United S

In a truth table produced by using TOSMANA 1.3 program, various conditions can be compared against each other and ideally against an outcome, adolescents' happiness level. Venn diagrams below illustrate the logical relationships between conditions. Each space in a diagram can be color coded, shaded or patterned. Figure 2is a graphical depiction of the configurations from the truth values presented in Table 4 and was produced by TOSMANA 1.3's 'visualizer' tool.

Figure 2
VENN DIAGRAM OUTPUT FROM THE TOSMANA PROGRAM



In the diagram, [1], or a positive outcome, is shaded green, [0], or a negative outcome, is shaded lilac and [C], or contradictory configurations, are patterned with green and lilac stripes, Contradictory configurations occur in cases where some combinations of conditions result in a [0] outcome, but others result in a [1] outcome (Wiechula, 2012). Blank white spaces are logical remainders [R], or combinations of conditions that have not been observed. For example, the lower left space the notation 01000 and highlights the absence of any combination of conditions associated with a positive outcome. Table 6 below shows four configurations associated with high level of adolescents' happiness in OECD countries.

Table 6
PRIME IMPLICANTS ASSOCIATED WITH ADOLESCENTS' HAPPINESS

Configurations	Country	Remarks
tepc(0)*gdp(0)*edusys(0)*puptea(1)	United Kingdom, Portugal	2 countries
tepc(1)*edusys(0)*puptec(0)	Austria, Portugal, United States	3 countries
tepc(1)*gdp(1)*edusys(1)*puptea(0)	Switzerland, Norway	2 countries
tee(0)*tepc(0)*gdp(1)*edusys(1)	Netherlands, Ireland, France, Germany	3 countries

As shown in Table 6, there are four simplified prime implicants explaining adolescents' happiness in OECD countries. They are summarized as follows:

tee_1 * GDP_1 * EDUSYS_1 * puptea_1 +tee_1 * tepc_1 * GDP_1 * EDUSYS_1 + tepc_1 * GDP_1 * edusys_1 * puptea_1 +TEE_1 * tepc_1 * gdp_1 * edusys_1

Model 1 is a configuration of three variables (low total per capita expenditure on education, low per capita GDP, low level of meeting the needs of a competitive economy), and includes United Kingdom and Portugal Model 2 is a configuration of three variables (low total per capita expenditure on education, low level of meeting the needs of a competitive economy, low ratio of students to teaching staff, and includes Austria, Portugal, and United States. Model 3 is a configuration of four variables (high total per capita expenditure on education, high per capita GDP, high ratio of students to teaching staff, and high total expenditure on education as a percentage of GDP), and includes Switzerland and Norway. Model 4 is a configuration of four variables (low total expenditure on education as a percentage of GDP, low total per capita expenditure on education, high per capita GDP, high level of meeting the needs of a competitive economy), and includes Netherlands, Ireland, France, and Germany.

CONCLUSIONS

This paper emphasizes the importance of adolescents' happiness, describes the usefulness of QCA in examining what causal conditions can influence high level of adolescents' happiness in OECD countries, and attempts to discover configurations associated with adolescents' happiness and simple prime implicants relating to the solution. In this analysis, six configurations affecting adolescents' happiness and four prime implicants, which are sets of conditions suggesting a relationship or solution between the conditions, are derived. QCA is an alternative approach to analysis in adolescents' happiness that involves truth tables, Boolean algebra and search for a greater understanding of causal conditions. The use of QCA has been rarely reported in adolescents' happiness studies, and are likely to be conceptual and paradigmatic challenges to its adoption in some settings. Proposals for follow-up studies are as follows. Only 22 out of the 34 OECD countries were all included in the data reported from IMD, OECD and HSBC, and thus in follow-up studies data that can include more countries should be considered. Also, to derive educational implications to enhance the happiness of adolescents in OECD countries in an integrated perspective there is a need to conduct researches by including other educational factors. More interesting and valid conclusions could be drawn from a more global study that could consider non-economic and non-financial factors, such as organizational structure and adequacy of teaching method.

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea Grant Funded by the Korean Government (NRF-2015S1A5B8046954)

REFERENCES

Adam A, Delis M & Kammas P (2008) *Fiscal decentralization and public sector efficiency: evidence from OECD countries*. CESIFA working paper no. 2364.

Biever T & Martens K (2011) The OECD PISA study as a soft power in education? Lessons from Switzerland and US. *European Journal of Education*, 46(1), part 1.

Borgonovi F & Montt G (2012) *Parental involvement in selected PISA countries and economies*. OECD Education working paper no. 73.

Cakar F & Karatas Z (2012) The self-esteem, perceived social support and hopelessness in adolescents: the structural equation modeling. *Educational Sciences: Theory and Practice* 12(4),2406-2412.

Chien H, Kao C, Yeh I & Lin K (2012) Examining the relationship between teachers' attitudes and motivation toward web-based professional development: a structural equation modeling approach. *TOJET*, 11(2),120-127.

Choi, Young-Chool (2008) Relationships between national competitiveness and decentralization. *Korean Association of Local Government Studies Summer Conference Proceedings*.

Choi, Young-Chool & Jang, Ji-Hyun (2015) Relationships Among Social Policy Factors, National
Competitiveness and Happiness. *Applied Research in Quality of Life*. DOI 10.1007/s11482-015-9429-9424

Enikolopov R & Zhuravskaya E (2007) Decentralization and political institutions. *Journal of Public Economics*, 91, 2261-2290.

Fisman R & Gatti R (2002) Decentralization and corruption: evidence across countries. *Journal of Public Economics*, 83,325-346.

Gao S, Mokhtarian P & Johnston R (2008) Exploring the connections among job accessibility, employment, income, and auto ownership using structural equation modeling. *Ann Reg Sci*, 42, 341-356.

Hayduck LA (1987) *Structural Equation Modeling with LISREL: Essentials and advances*. Baltimore, MD: Johns Hopkins.

Holzinger K & Knill C (2008) Theoretical framework: causal factors and convergence expectations. in K Holzinger, C Knill & B Arts (eds), *Environmental Policy Convergence in Europe: The impact of international institutions and trade*. Cambridge: Cambridge University Press.

Huh J (2013) *Advanced Structural Equation Modeling by AMOS*. Seoul: Hanare Academy.

IMD (2013) *World Competitiveness Yearbook*. Geneva: IMD.

KEDI (2010) *Analysis of Effects of Education on National Competitiveness*. Seoul: KEDI.

KICE (Korea Institute for Curriculum and Evaluation). Homepage.

Laglera JM, Collado J & Oca JAM (2013) Effects of leadership on engineers: a structural equation model. *Engineering Management Journal*, 25(4),7-16.

Lee C & Lee KH (2006) Analysis of the Conditions of Korea Education Competiveness Index of IMD World Competitiveness Yearbook. *The Journal of Korean Education*, 33(1),173-197.

Lingard B & Grek, S (2007) *The OECD, indicators and PISA: an exploration of events and theoretical perspectives*. Edinburgh, ESRC/ESP Research Project.

OECD (2010) *Education at a Glance*. Paris: OECD.

OECD (2013) *PISA 2012 Results in Focus*. Paris: OECD.

Ragin C (2000) *Fuzzy-Set Social Science*. Chicago: The University of Chicago Press.

Rowan, Correnti & Miller (2002) *What large scale, survey research tells us about teacher effects on student achievement: insight from the "prospect" study of elementary schools*. CPRE research report series.

Shin HS & Joo YH (2013) Global governance and educational policy in Korea. *Korean Journal of Educational Research*, 51(3),133-159.

Tanzi V & Schuknecht L (1998) Can small governments secure economic and social well being? in Grubel H (ed.), *How To Spend the Fiscal Dividend: What is the optimal size of government?*. Vancouver: Fraser Institute.

Thygeson MM, Solberg L, Asche SE, Fontaine P, Pawlson LG & Scholle SH (2011) Using Fuzzy Set Qualitative Comparative Analysis to Explore the Relationship between Medical Homenss and Quality. *Health Research and Education Trust*. DOI: 10.1111/J.1475.

Yavuz M (2009) Factors that affect mathematics-science (MS) scores in the secondary education institutional exam: an application of structural equation modeling. *Educational Sciences: Theory and Practice*, 9(3),1557-1572.

Zeng, Jinghan (2013) What matters most in selecting top Chinese leaders? *Journal of CHIN POLIT SCI*, 18:223-239.

INTEGRATION AND DYNAMIC LINKAGES IN INTERNATIONAL STOCK MARKETS IN LIGHT OF THE RECENT US FINANCIAL CRISIS-AN INTROSPECT

Ranjan Dasgupta, Xavier University Bhubaneshwar (XUB)

ABSTRACT

This study aims at investigating the short-run dynamic linkages and long-run integration of 27 countries all over the world under trade-agreement or economic-status based selected panels (regional mostly) to find out the most attractive international portfolio diversification opportunities in between January, 2005- June, 2012 overall and as divided pre-, during-, and post-US financial crisis periods. It undertakes descriptive statistics, correlation tests, pair-wise Granger causality tests and Johansen and Juselius's co-integration technique to fulfill its objectives.

The empirical results show that under sub-periods, many of these international markets have short-run relationships, few significant unidirectional but no bidirectional causal relationships and presence of some long-run integration effects. However, for the overall study period, many such results contradict with sub-period results, especially in the long-run. Long-run co-integration results show all round integration among the paneled stock markets which nullify the portfolio diversification opportunities for the international investors within such panels. Sub-periods results also show that these markets are mostly integrated, especially during and post-crisis periods.

So, it can be concluded that individual opportunities are available within regions or similar markets for international investors to diversify, although these paneled markets are not dynamically interlinked in the short-run, but showing presence of long-run integrations.

INTRODUCTION

Numerous empirical studies from all over the world has taken stock markets integration as the topic of investigation all these years. These studies centered on how one country is integrated with another or few others in regard to trade-relationships, economic development, financial influence, etc. Many such studies have also investigated region-wise stock markets integration. But, till date there are no such studies which investigate the stock markets integration of different regions based on international trade agreements, economic status and stock markets dependence. So, this study is one of the pioneering natures in this regard. It has undertaken BRIC (Brazil, Russia, India, China); SAARC [South Asian Association of Regional Cooperation] (India, Pakistan, Sri Lanka, Bangladesh); ASEAN [Association of South-East Asian Nations] (Singapore, Indonesia, Malaysia, Philippines); EU [European Union] (Germany, UK, France, Spain); NAFTA [North American Free Trade Agreement] (USA, Canada, Mexico); LAFTA [Latin American Free Trade Agreement] (Argentina, Brazil, Chile, Peru); and MENA [Middle East North Africa] (Egypt, UAE, Saudi Arabia, Iran) stock markets under Panel A-G to investigate how these markets behave, relate and impact all other markets within same Panel

(and mostly regional) both in the short and long-run. These results automatically convey the international portfolio diversification opportunities as available to the above country-specific investors.

To fulfill the above objectives, this study uses graphical presentations, descriptive statistics results (to verify the nature and normality of the data series), correlation test results, Augmented Dickey-Fuller (ADF) (Dickey and Fuller 1979; 1981) tests and Phillips-Perron (PP) (1988) tests (to find out the unit-roots if any), Johansen and Juselius's (JJ) (1990) co-integration technique and Granger's (1969) pair wise causality test.

However, whenever such a worldwide integration study has to be undertaken it is imperative to take into consideration the financial situations as available in the international stock markets arena. It is a known fact that financial crises, such as the October 1987 US stock market crash, the Asian financial crises in 1997, the bursting of the technological bubble in 2000, and the latest US sub-prime crisis in 2007-09 have impacted negatively most of the international stock markets in most countries.

The financial crisis of 2007-09 is undisputedly one of the deepest, broadest and most complex crises since the Great Depression of the 1930s. Although it had started in July 2007, the first indication of a serious crisis appeared in January 2008. On 15th January, 2008 the news of a sharp decline in the profits of the Citigroup banking led to a sharp fall in the New York Stock Exchange (NYSE). A few days later on 21st January, 2008 a spectacular fall in indices prices occurred in all major stock markets globally, followed by a series of collapses (Gokay, 2009). After the collapse of Lehman Brothers, the takeover of the stock-broking firm and investment bank Merrill Lynch, and the move by Goldman Sacks and Morgan Stanley to seek banking status in order to receive protection from bankruptcy in September 2008, the crisis spread rapidly across institutions, markets, and borders. There were massive failures of banking and financial institutions, signs of economic recessions in most parts of the world, and a staggering collapse in asset values in developed and developing countries alike. Then, the US government made its most dramatic interventions in financial markets since the 1930s to stop further collapse and to ward off total economic catastrophe. The infusion of hundreds of billions of dollars into the US banking system coinciding with equally colossal interventions in Europe staved off an entire crash of the world's financial markets. The IMF (2009) pointed out that starting in February 2009, Asia's economy began to revive, and stock markets seemed to regain their confidence in the last half of 2009. The stock markets in other parts of the world follow the suit.

Bekaert et al. (2002); Karolyi and Stultz (1996); Lin et al. (1994); Longin and Solnik (1995; 2001); etc. also observed that integration of international stock markets is a time-varying concept. So, longitudinal studies should be undertaken to get authentic results.

To fulfill the above objectives, this study has undertaken monthly returns of all the above stock markets under different Panels for the period January, 2005 - June, 2012. The overall period (i.e., January, 2005 - June, 2012) is divided into three sub-periods, namely pre-crisis period (January, 2005 - June, 2007 [30 months]), during-the-crisis period (July, 2007 - December, 2009 [30 months]), and post-crisis period (January, 2010 - June, 2012 [30 months]). Thus, this study has taken a balanced perspective in regard to monthly returns [30 months each] under all sub-periods.

It is also immensely timely and critical for the policy-makers, investors - domestic and international, market participants, and all other stakeholders interested in investing in international stock markets to judge the degree of integration and interdependence in between these Panel countries. Researchers and academicians will also take keen interest in finding the

nook and corners of such a stock markets integration study internationally amidst these crisis-periods.

The rest of the paper is organized as follows. A review of the relevant few existing literature including empirical evidences on short and long-run dynamic linkages and integration in between these Panel stock markets is undertaken next. Then, this study discusses the research methodology used for investigation and analysis purposes and presents data descriptions. Following that it reports empirical results and subsequent discussions followed by conclusion at last.

REVIEW OF LITERATURE

Though there are many studies investigating stock markets integration in the short and long-run, but this study takes into consideration only the relevant ones. In one of the earliest studies of panel data investigation, Ratanapakorn and Sharma (2002) examined the short and long-run dynamics across five regional stock markets (Asia, Europe, Eastern Europe-Middle East, Latin America and the USA) during pre-Asian crisis and crisis period. Results indicate no long-run relationships before the Asian crisis. Though, some evidences of long-run and significant short-run relationships were observed during the crisis period. Main inference of this study is that the Asian financial crisis has increased the integration process among these markets. Hooy and Goh (2007)'s study contributes to understand the driving forces for the process of stock market integration. Based on 26 stock markets of countries affiliated to five trading blocs, the results show that market attributes, economic fundamentals and world information are significant in explaining world stock market integration. The integration process is found to be significantly weakened during the world recession in 2001. The results highlight that regionalism due to economic bloc plays an important role in stock market integration. The level of integration is highest among stock markets in the EU countries while those in EFTA and AFTA are most segmented.

In a recent study, Graham et al. (2012) examined the co-movements of 22 emerging stock markets located in the Americas, Asia, Europe and Middle East/Africa with the US stock market by employing the wavelet analysis method. Findings of this study indicate that between the USA and 22 emerging markets have the higher degree of co-movements. Their results also show that the strength of co-movement varies by country. Results further suggest that investors can obtain significant diversification benefits by investing selectively in these markets; though it all depends on the investment horizon. Similarly, Frijns et al. (2012) explored the role of political crisis in explaining the change in the degree of stock market integration in 19 emerging stock markets from the regions of Central and Eastern Europe, Latin America and South and East Asia for the period of 1991 to 2006. Results show that certain characteristics of crises particularly political crisis and its severity and the involvement of the USA in the conflict may generally reduce the level of stock market integration.

Dasgupta (2013) aims at investigating the relative integration and dynamic linkages of the emerging economies all over the world and the US with India to find the most attractive international portfolio diversification opportunities between 2003-12 for the overall study period and for pre-, during-, and post-US financial crisis periods. It undertakes pair-wise Granger causality test, Johansen and Juselius's and Engle-Granger's co-integration techniques, and Vector auto regressions to fulfill its objectives. The results show many unidirectional but no bidirectional causal relationships and some long-term integration in between above markets. He

concludes that these emerging economies stock markets are the most favourable investment destinations for the US and global investors especially China, Brazil and India.

However, no study is found till date involving the international stock markets based on above trade agreements or economic status and before, during, and after the very recent US sub-prime crisis. Also, the comparative evaluation of these countries under and as separate panels and on an overall basis to find the most profitable of diversification opportunities among them is also a new domain as undertaken under this study.

RESEARCH METHODOLOGY

Monthly returns are identified as the difference in the natural logarithm of the closing index value for the two consecutive trading months. It can be presented as:

$$R_t = \log(P_t/P_{t-1}) \quad (1)$$

Where R_t is logarithmic monthly return at time t. P_{t-1} and P_t are monthly prices of the indices at two successive months, t-1 and t respectively.

Augmented Dickey-Fuller (ADF) tests are employed to test the validity of market integration hypothesis by detecting the presence of stationarity in the data series. The early and pioneering work on testing for a unit-root in time series data was done by Dickey and Fuller (1979; 1981). If a time series is non-stationary, one can study its behaviour only for the time-period under consideration. It is not possible to generalize it to other time-periods. It will, therefore, not useful for forecasting purposes.

This study uses the following equation to test for unit-roots through ADF tests:

$$\Delta y_t = \alpha_0 + \lambda y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (2)$$

Where, α_0 is a constant, λ is the coefficient of y_{t-1}, p is the lag order of autoregressive process, $\Delta y_t = y_t - y_{t-1}$ are first differences of y_t, y_{t-1} are lagged values of order one of y_t, Δy_{t-i} are changes in lagged values, and u_t is white noise. Thus, I have tested the null hypothesis of $\lambda = 0$ against the alternative hypothesis of $\lambda < 0$. The null hypothesis of non-stationarity is rejected if λ is negative and significantly different from zero.

This study has also used the following equation to test for unit-roots through PP tests which is the AR(1) process:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + e_t \quad (3)$$

Where, Y_t represents a stock price series (in logarithmic form), b_0 is a constant, and e_t are error terms. The PP test statistics are based on the Phillips Z-Test.

The objective of the co-integration test is to determine whether a group of non-stationary data series is co-integrated or not. The presence of co-integrating relations forms the basis of the Vector Error Correction Model (VECM) specification. The tests for the presence of co-integration is performed when all the returns series are non-stationary and integrated of the same order. In this study, the Johansen and Juselius's (1990) Trace and Maximum Eigenvalue tests have been employed to test the long-run relationships among the selected stock markets' monthly returns series of the Panel datasets. To fulfill the above objectives the following VECM-specific equation is used:

$$\Delta y_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \varepsilon_t \quad (4)$$

Where,

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j \quad \text{and} \quad \Pi = -I + \sum_{i=1}^{p} A_i \tag{5}$$

Here, the Trace and Maximum Eigenvalue tests have been used to find the number of co-integrating vectors. The equations for these tests are as follows:

$$J_{trace} = -T \sum_{i=1+r}^{n} \ln(1 - \hat{\lambda}_i) \tag{6}$$

$$J_{max} = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{7}$$

Where, T is the sample size and $\hat{\lambda}_i$ is the ith largest canonical correlation. The Trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The maximum Eigenvalue test, on the other hand, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of r+1 co-integrating vectors. If the test statistic is greater than the critical value from the Johansens's tables, I will reject the null hypothesis that there are r co-integrating vectors in favour of the alternative hypothesis under the said tests in line with Brooks (2002).

Investigation of these stock markets' integration is to be extended by employing Granger's (1969) pairwise causality tests. Granger (1969) observed that a time series X_t Granger-causes another time series Y_t if the latter can be predicted with better accuracy by using past values of X_t rather than by not doing so, other information being identical. Testing causal relations between two stationary series ΔX_t and ΔY_t is based on the following two equations:

$$\Delta Y_t = \alpha_0 + \sum_{k=1}^{p} \alpha_k \Delta Y_{t-k} + \sum_{k=1}^{p} \beta_k \Delta X_{t-k} + \mu_t \tag{8}$$

$$\Delta X_t = \varphi_0 + \sum_{k=1}^{p} \varphi_k \Delta X_{t-k} + \sum_{k=1}^{p} \Phi \Delta Y_{t-k} + \upsilon_t \tag{9}$$

Where Δ is the difference operator, Y_{t-k} and X_{t-k} represent the lagged value of Y_t and X_t, μ_t and υ_t are disturbance terms assumed to be white noise. The lag length (k = 1, 2, ..., p) is chosen by using the Akaike information criterion (AIC). The null hypothesis that X_t does not Granger cause Y_t is not accepted if the β_k's (k>0) are significantly different from zero using standard F test (the statistic is for the joint hypothesis $\beta_1 = \beta_2 = ... = \beta_k = 0$). Similarly, Y_t Granger-causes X_t if the Φ_k's, k>0, are jointly different from zero.The details of the selected international stock indices under different Panels are summarized in Table 1 and 2.

Table 1
PANEL DATA (COUNTRIES)

Panel A (BRIC)	Panel B (SAARC)	Panel C (ASEAN)	Panel D (EU)	Panel E (NAFTA)	Panel F (LAFTA)	Panel G (MENA)
Brazil	India	Singapore	Germany	USA	Argentina	Egypt
Russia	Pakistan	Indonesia	UK	Canada	Brazil	UAE
India	Sri Lanka	Malaysia	France	Mexico	Chile	Saudi Arabia
China	Bangladesh	Philippines	Spain		Peru	Iran

Table 2
PANEL DATA (INDICES) [ABBREVIATION USED UNDER THIS STUDY]

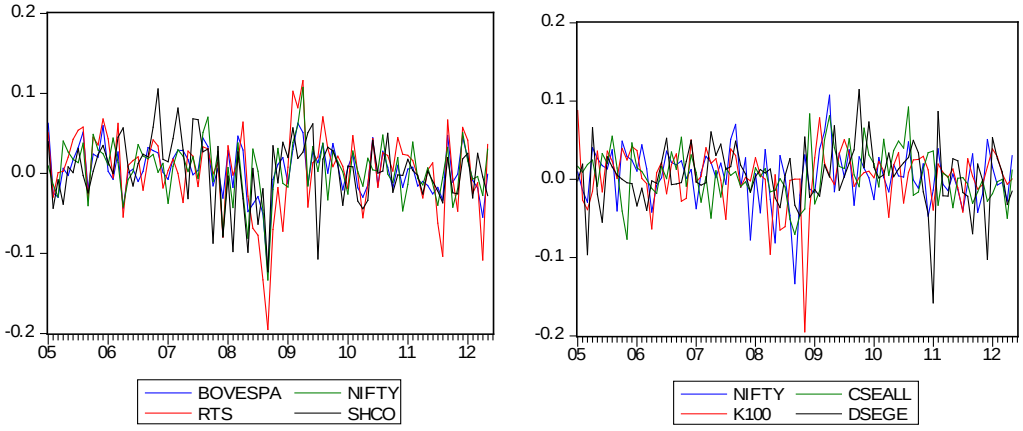
Panel A (BRIC)	Panel B (SAARC)	Panel C (ASEAN)	Panel D (EU)	Panel E (NAFTA)	Panel F (LAFTA)	Panel G (MENA)
Bovespa [BOVESPA]	S&P CNX Nifty [NIFTY]	Straits Times [ST]	DAX 30 [DAX30]	NASDAQ Composite [NASDAQCO]	MerVal [MV]	CMA [CMA]
RTS [RTS]	Karachi 100 [K100]	Jakarta Composite [JACO]	FTSE 100 [FTSE100]	S&P TSX Composite [TSXCO]	Bovespa [BOVESPA]	UAE General [UAEGE]
S&P CNX Nifty [NIFTY]	CSE All Share [CSEALL]	KLSE Composite [KLSECO]	CAC 40 [CAC40]	IPC All Share [IPCALL]	IPSA [IPSA]	Tadawul All Share [TAALL]
Shanghai Composite [SHCO]	DSE General [DSEGE]	PSE Composite [PSECO]	IBEX 35 Sociedad de Bolsas SA [IBEX35]		Lima General [LIGE]	TSE 50 [TSE50]

Overall period – January 2005-June 2012
Pre-crisis period – January 2005-June 2007 (30 months)
During-the-crisis period – July 2007-December 2009 (30 months)
Post-crisis period – January 2010-June 2012 (30 months)

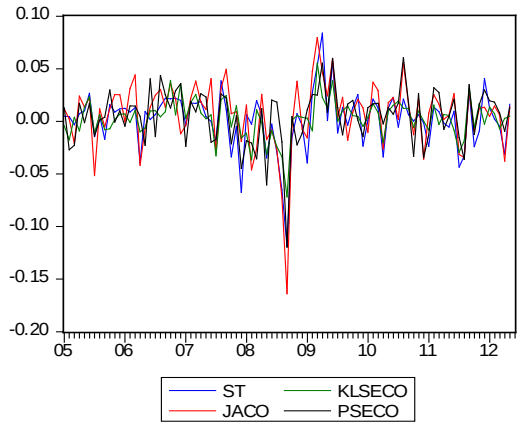
RESULTS AND DISCUSSIONS

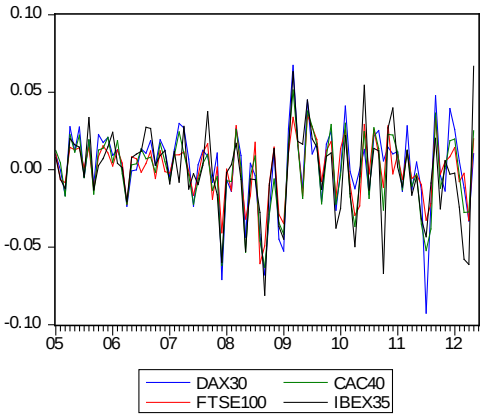
Figure 1
OVERALL STUDY PERIOD (JANUARY, 2005 – JUNE, 2012)

Panel A- BRIC **Panel B- SAARC**

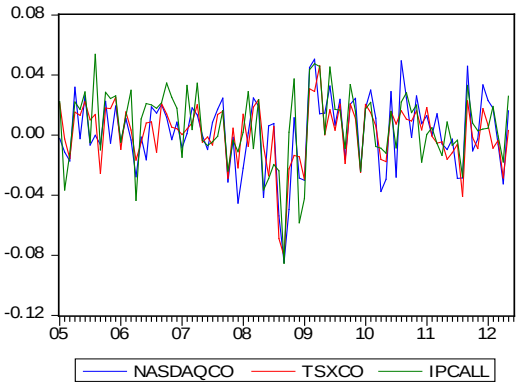


Panel C- ASEAN **Panel D- EU**

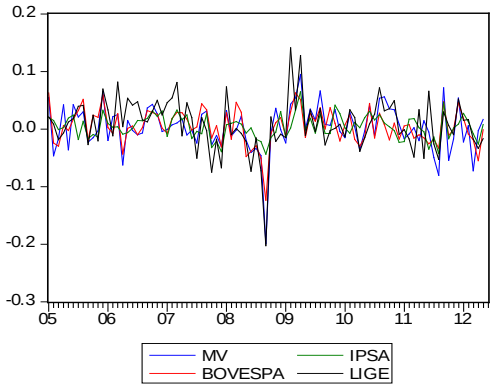




Panel E- NAFTA



Panel F- LAFTA



Panel G- MENA

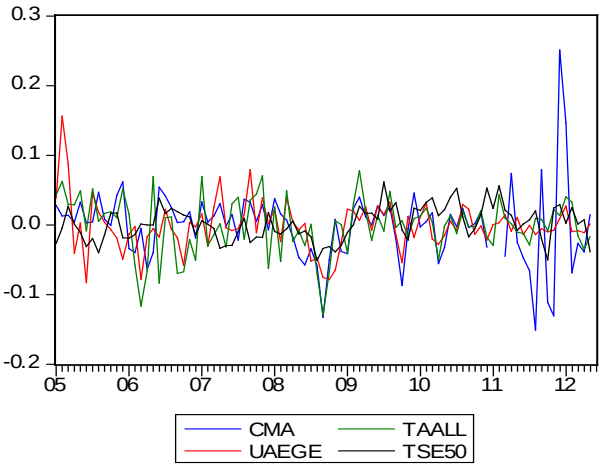
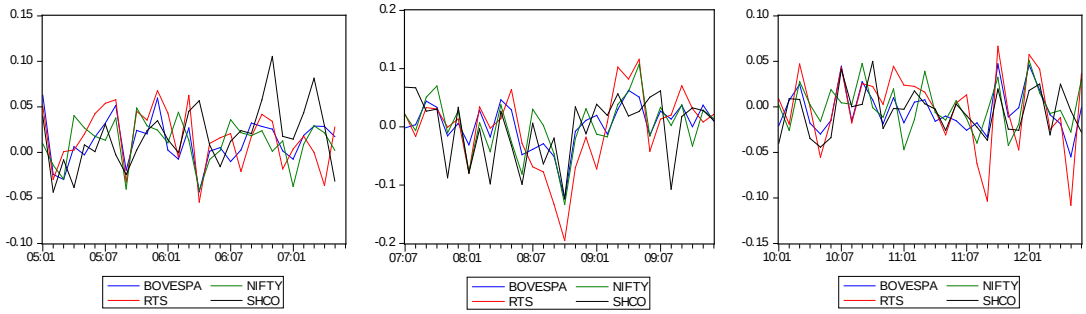


Figure 2
SUB-PERIODS
[PRE-CRISIS (JANUARY, 2005 – JUNE, 2007), DURING-THE-CRISIS (JULY, 2007 – DECEMBER, 2009) AND POST-CRISIS (JANUARY, 2010 – JUNE, 2012)]

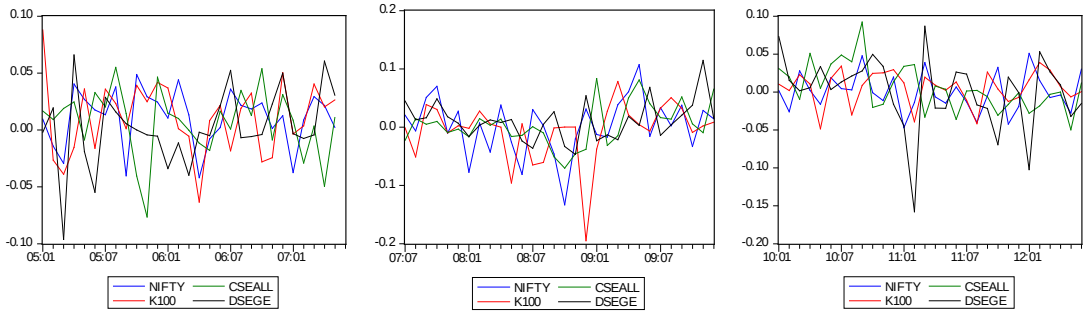
Panel A - BRIC

BRIC- Pre **BRIC- During** **BRIC- Post**



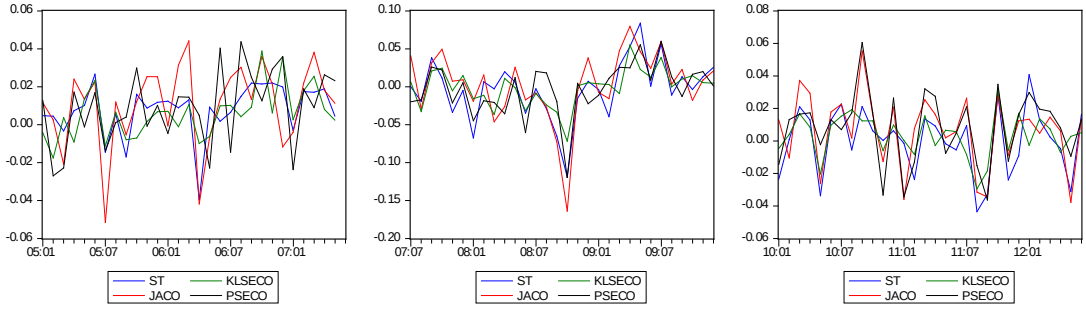
Panel B – SAARC

SAARC- Pre **SAARC- During** **SAARC- Post**



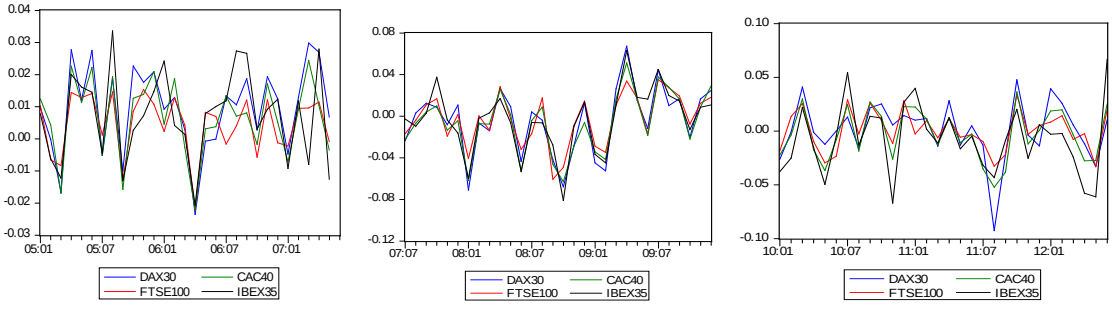
Panel C – ASEAN

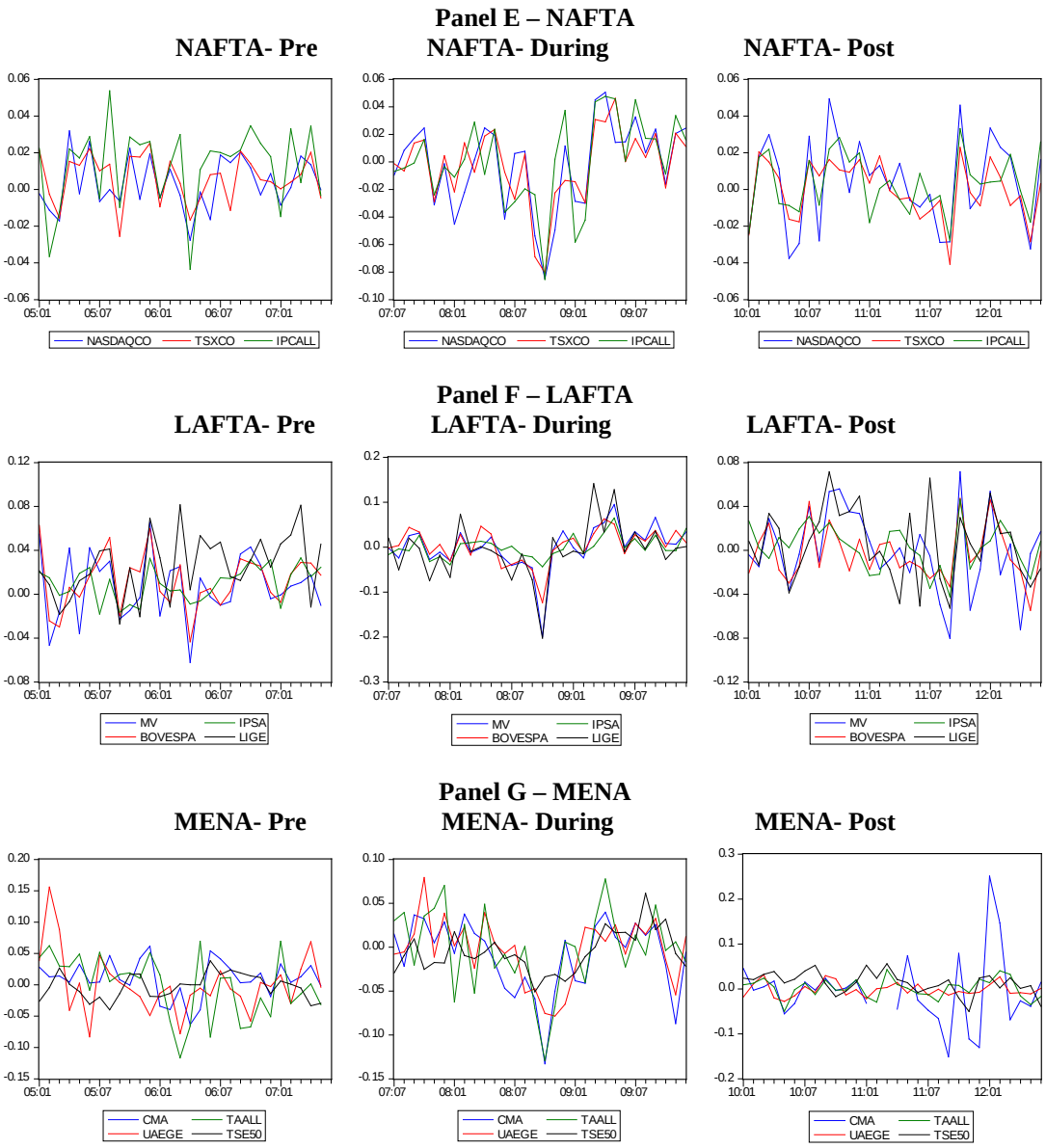
ASEAN- Pre **ASEAN- During** **ASEAN- Post**



Panel D – EU

EU- Pre **EU- During** **EU- Post**





This study has used graphical presentations (see Fig. 1 and 2) and descriptive statistics results to find out the normality of the indices returns data series during the overall and under different sub-periods. It is found from the graphs that volatility and non-normality is maximum during-the-crisis periods for all Panel indices returns. Except BRIC all other panels are also showing extreme volatility in pre and post-crisis periods. In most of the panels strong comovements and domination and influence by one or two indices are also evident during all periods and both in the short and long-run. However, some reverse movements within the regional panels especially in case of SAARC, etc. are also seen under this study. This is in line with the graphical presentation for the overall study period (see Figure. 1).

Table 3.1 and 3.2 gives the summary of descriptive statistics of the index returns of all the selected indices for the overall study period and all sub-periods. Except France and Spain from the EU panel (i.e., Panel D) and all the MENA countries (except Iran), all other paneled stock markets earn positive returns during the overall study period. However, the average

monthly indices returns results show that many of the countries under different panels earn a negative return for the investors mainly during-the-crisis period and sometimes in the post-crisis

Table 3.1
DESCRIPTIVE STATISTICS (OVERALL STUDY PERIOD)

Panels	Mean	Std. Dev.	Skewness	Kurtosis
Panel A (BRIC)				
BOVESPA	0.003918	0.030350	–0.691695	5.164216
RTS	0.003665	0.050181	–1.010063	5.199672
NIFTY	0.004598	0.034858	–0.660621	5.293668
SHCO	0.003047	0.041624	–0.670501	3.901915
Panel B (SAARC)				
NIFTY	0.004598	0.034858	–0.660621	5.293668
K100	0.003492	0.037064	–1.928374	11.26888
CSEALL	0.005374	0.032233	0.159977	3.347085
DSEGE	0.004432	0.039422	–0.761930	6.146896
Panel C (ASEAN)				
ST	0.001547	0.027012	–1.029039	7.377706
JACO	0.006493	0.032130	–1.794408	10.62672
KLSECO	0.002718	0.017959	–0.680978	6.017117
PSECO	0.004658	0.026661	–1.201846	7.140356
Panel D (EU)				
DAX30	0.002004	0.025829	–0.945979	5.012881
FTSE100	0.000674	0.018991	–0.686668	3.497389
CAC40	–0.000988	0.023362	–0.576986	3.031972
IBEX35	–0.001276	0.027455	–0.419659	3.714185
Panel E (NAFTA)				
NASDAQCO	0.001722	0.024514	–0.647457	3.768851
TSXCO	0.001128	0.020064	–1.251269	6.058317
IPCALL	0.005472	0.024592	–0.745634	4.144763
Panel F (LAFTA)				
MV	0.002613	0.039811	–1.356497	9.053062
BOVESPA	0.003918	0.030350	–0.691695	5.164216
IPSA	0.004335	0.020529	–0.008471	3.037366
LIGE	0.008049	0.046003	–0.713002	7.366195
Panel G (MENA)				
CMA	–0.001768	0.054083	0.739174	8.376674
UAEGE	–0.001454	0.036032	0.783963	6.741040
TAALL	–0.001179	0.040496	–0.635818	3.639440
TSE50	0.000813	0.023817	0.083161	2.642769

Table 3.2
DESCRIPTIVE STATISTICS (SUB-PERIODS)

BRIC	Pre-crisis period – January 2005-June 2007 (30 months)				During-the-crisis period – July 2007-December 2009 (30 months)				Post-crisis period – January 2010-June 2012 (30 months)			
	BOVESPA	RTS	NIFTY	SHCO	BOVESPA	RTS	NIFTY	SHCO	BOVESPA	RTS	NIFTY	SHCO
Mean	0.012035	0.016343	0.011102	0.017446	0.003357	-0.003949	0.002693	-0.002222	-0.003367	-0.000975	0.000215	-0.005603
Std. Dev.	0.025241	0.032262	0.024609	0.033728	0.038402	0.067355	0.048914	0.056865	0.024168	0.043087	0.025373	0.024737
Skewness	-0.036371	-0.370465	-0.780218	0.432493	-1.163354	-0.729994	-0.572184	-0.825522	0.513102	-0.816472	0.186261	0.334976
Kurtosis	2.799916	2.303558	2.907302	3.359738	5.111079	3.785287	3.797962	2.388330	2.978741	3.360093	2.493390	2.317507
SAARC	**NIFTY**	**K100**	**CSEALL**	**DSEGE**	**NIFTY**	**K100**	**CSEALL**	**DSEGE**	**NIFTY**	**K100**	**CSEALL**	**DSEGE**
Mean	0.011102	0.010685	0.006642	0.002295	0.002693	-0.005550	0.003977	0.010811	0.000215	0.005580	0.005545	0.000119
Std. Dev.	0.024609	0.031909	0.029483	0.033910	0.048914	0.050423	0.036759	0.033610	0.025373	0.022412	0.030962	0.049093
Skewness	-0.780218	-0.089089	-0.825750	-0.494621	-0.572184	-1.891654	0.410358	0.895287	0.186261	-0.913290	0.622996	-1.198890
Kurtosis	2.907302	3.056699	3.888659	4.213675	3.797962	8.007689	2.978817	4.454773	2.493390	3.208563	3.401359	5.318348
ASEAN	**ST**	**JACO**	**KLSECO**	**PSECO**	**ST**	**JACO**	**KLSECO**	**PSECO**	**ST**	**JACO**	**KLSECO**	**PSECO**
Mean	0.007881	0.010723	0.005852	0.008926	-0.002932	0.002453	-0.000900	-0.002647	-9.61E-05	0.006445	0.003305	0.007839
Std. Dev.	0.013681	0.022098	0.013287	0.019615	0.039442	0.045927	0.024799	0.034828	0.020350	0.022739	0.013022	0.022105
Skewness	-1.635261	-1.134275	0.680714	-0.240750	-0.577734	-1.506830	-0.513710	-1.136990	-0.364232	-0.416241	-0.425708	-0.218223
Kurtosis	6.322689	4.161941	3.330479	2.245696	4.435408	6.964285	4.115272	5.652117	2.531209	2.791096	3.221223	3.001547
EU	**DAX30**	**FTSE100**	**CAC40**	**IBEX35**	**DAX30**	**FTSE100**	**CAC40**	**IBEX35**	**DAX30**	**FTSE100**	**CAC40**	**IBEX35**
Mean	0.009469	0.004625	0.006535	0.007174	-0.004281	-0.002888	-0.006234	-0.003198	0.001074	0.000417	-0.003013	-0.007520
Std. Dev.	0.013400	0.009333	0.012184	0.014002	0.032090	0.025096	0.029067	0.030477	0.026903	0.018752	0.024056	0.032460
Skewness	-0.570846	-1.033455	-0.626100	-0.067163	-0.272407	-0.467507	-0.241447	-0.466542	-1.130016	-0.021336	-0.144903	0.205478
Kurtosis	2.840809	3.561726	2.769757	2.257901	2.847592	2.429024	2.483984	3.570561	6.151294	2.181673	1.935261	2.792554
NAFTA	**NASDAQCO**	**TSXCO**	**IPCALL**		**NASDAQCO**	**TSXCO**	**IPCALL**		**NASDAQCO**	**TSXCO**	**IPCALL**	
Mean	0.003488	0.006181	0.012976		-0.001988	-0.002444	0.000444		0.003725	-0.000185	0.003248	
Std. Dev.	0.014337	0.013128	0.021732		0.031956	0.027642	0.032095		0.024133	0.015829	0.016170	
Skewness	0.049537	-0.644981	-0.884637		-0.671610	-0.971633	-0.554915		-0.037358	-0.605617	-0.016224	
Kurtosis	2.384016	2.608468	3.551301		2.872055	4.150726	3.163011		2.060600	2.816284	2.097047	

LAFTA	MV	BOVESPA	IPSA	LIGE	MV	BOVESPA	IPSA	LIGE	MV	BOVESPA	IPSA	LIGE
Mean	0.006990	0.012035	0.009748	0.026222	0.000834	0.003357	0.000457	-0.006610	0.000161	-0.003367	0.002980	0.005141
Std. Dev.	0.030151	0.025241	0.015682	0.029439	0.050296	0.038402	0.024035	0.062214	0.037059	0.024168	0.020420	0.033961
Skewness	-0.195317	-0.036371	-0.254822	-0.009744	-1.857653	-1.163354	0.539955	-0.337840	-0.175564	0.513102	-0.262323	0.070223
Kurtosis	2.670091	2.799916	1.933026	2.286782	9.587300	5.111079	3.317641	5.734677	2.752229	2.978741	2.751918	2.203645
MENA	**CMA**	**UAEGE**	**TAALL**	**TSE50**	**CMA**	**UAEGE**	**TAALL**	**TSE50**	**CMA**	**UAEGE**	**TAALL**	**TSE50**
Mean	0.009735	0.001303	-0.002484	-0.003032	-0.009682	-0.003708	-0.001886	-0.005865	-0.005202	-0.001892	0.000931	0.011948
Std. Dev.	0.029264	0.048210	0.049573	0.019949	0.040949	0.036776	0.045767	0.024003	0.080021	0.016079	0.020447	0.024111
Skewness	-0.524231	1.057981	-0.456060	0.040356	-1.067141	-0.325353	-0.607995	0.629205	1.069423	0.651857	-0.410711	-0.672964
Kurtosis	3.103270	5.273449	2.361910	2.199676	3.946261	2.874135	3.410905	3.482309	5.451382	2.490650	3.032993	3.494053

period. But, this is not true in case of pre-crisis period. This clearly implies that the said US crisis has had strong impact on most international stock markets returns. The SD results for all these panel indices during the study period (especially during-the-crisis period) have also implied highly volatile stock markets. The value of skewness has pointed out that except few indices returns under each study period the others have higher values (mostly negatively skewed) during all the pre, during and post crisis periods. It is also mostly true for the overall study period. It also indicates a deviation from normal distribution of the data series and volatility in them. The value of kurtosis has suggested that during-the-crisis most of these panel indices returns has

leptokurtic distribution (i.e., >3) with values concentrated around the mean and thicker tails. This is in line with the overall study period. This means high probability for extreme values which is observed from the above tables. The kurtosis value of others during other periods though mostly indicates platykurtic distribution (i.e., <3) and the values are wider spread around the mean, but overall are mixed in results. All these imply non-normality and volatility in most of the indices returns series during the study period.

So, this study has used the ADF and PP tests to find out the stationarity, i.e., whether indices return data series contain any unit-root or not.

Table 4.1
AUGMENTED DICKEY-FULLER (ADF) AND PHILLIPS-PERRON (PP) TESTS RESULTS [WITH INTERCEPT AND NO TREND] (OVERALL STUDY PERIOD)

Indices	ADF Results	Conclusion	PP Results	Conclusion
BOVESPA	–5.445462*	I(0)	–7.687955*	I(0)
RTS	–3.733681*	I(0)	–6.632449*	I(0)
NIFTY	–6.443134*	I(0)	–8.688424*	I(0)
SHCO	–4.887372*	I(0)	–8.576849*	I(0)
NIFTY	–6.443134*	I(0)	–8.688424*	I(0)
K100	–6.863740*	I(0)	–8.362950*	I(0)
CSEALL	–5.309125*	I(0)	–7.454071*	I(0)
DSEGE	–6.338886*	I(0)	–9.530631*	I(0)
ST	–5.183453*	I(0)	–7.289260*	I(0)
JACO	–5.919626*	I(0)	–7.299418*	I(0)
KLSECO	–4.963687*	I(0)	–7.476087*	I(0)
PSECO	–5.789033*	I(0)	–8.750196*	I(0)
DAX30	–7.058461*	I(0)	–7.844642*	I(0)
FTSE100	–5.137716*	I(0)	–8.474026*	I(0)
CAC40	–6.839519*	I(0)	–7.546563*	I(0)
IBEX35	–7.128392*	I(0)	–7.669693*	I(0)
NASDAQCO	–6.089376*	I(0)	–7.767718*	I(0)
TSXCO	–5.003380*	I(0)	–7.339195*	I(0)
IPCALL	–6.168474*	I(0)	–8.486085*	I(0)
MV	–5.933821*	I(0)	–8.563934*	I(0)
BOVESPA	–5.445462*	I(0)	–7.687955*	I(0)
IPSA	–5.260912*	I(0)	–7.664420*	I(0)
LIGE	–4.402257*	I(0)	–8.109581*	I(0)
CMA	–7.543312*	I(0)	–8.079933*	I(0)
UAEGE	–6.224812*	I(0)	–6.724074*	I(0)
TAALL	–5.675060*	I(0)	–7.830200*	I(0)
TSE50	–4.277636*	I(0)	–5.068013*	I(0)

* MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at level).
** MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at 1st Difference).

Table 4.2
AUGMENTED DICKEY-FULLER (ADF) TEST RESULTS [WITH INTERCEPT AND NO TREND] (SUB-PERIODS)

Indices	Pre-crisis period – January 2005-June 2007 (30 months)		During-the-crisis period – July 2007-December 2009 (30 months)		Post-crisis period – January 2010-June 2012 (30 months)	
	ADF Results	Conclusion	ADF Results	Conclusion	ADF Results	Conclusion
BOVESPA	-3.701563*	**I(0)**	-2.638628*	**I(0)**	-3.731411*	**I(0)**
RTS	-3.475089*	**I(0)**	-4.446311**	**I(1)**	-4.708486*	**I(0)**
NIFTY	-4.119501*	**I(0)**	-3.086797*	**I(0)**	-6.309382*	**I(0)**
SHCO	-3.575037*	**I(0)**	-2.859705*	**I(0)**	-4.551655*	**I(0)**
NIFTY	-4.119501*	**I(0)**	-3.086797*	**I(0)**	-6.309382*	**I(0)**
K100	-4.185520*	**I(0)**	-3.547067*	**I(0)**	-5.347112*	**I(0)**
CSEALL	-3.297402*	**I(0)**	-2.791026*	**I(0)**	-2.714087*	**I(0)**
DSEGE	-3.866969*	**I(0)**	-3.089221*	**I(0)**	-4.178434*	**I(0)**
ST	-2.847919*	**I(0)**	-4.578812**	**I(1)**	-5.384996*	**I(0)**
JACO	-4.169940*	**I(0)**	-2.939416*	**I(0)**	-4.832143*	**I(0)**
KLSECO	-2.866998*	**I(0)**	-6.163451**	**I(1)**	-3.972954*	**I(0)**
PSECO	-3.313806*	**I(0)**	-2.824954*	**I(0)**	-4.683090*	**I(0)**
DAX30	-3.061784*	**I(0)**	-3.693593*	**I(0)**	-4.836040*	**I(0)**
FTSE100	-4.795163*	**I(0)**	-3.675389*	**I(0)**	-4.078423*	**I(0)**
CAC40	-4.031272*	**I(0)**	-3.704871*	**I(0)**	-4.353162*	**I(0)**
IBEX35	-3.479783*	**I(0)**	-3.658360*	**I(0)**	-5.358974*	**I(0)**
NASDAQCO	-3.087584*	**I(0)**	-3.129699*	**I(0)**	-4.244205*	**I(0)**
TSXCO	-4.477993*	**I(0)**	-4.868093**	**I(1)**	-3.170088*	**I(0)**
IPCALL	-4.041592*	**I(0)**	-3.357100*	**I(0)**	-4.156808*	**I(0)**
MV	-4.750746*	**I(0)**	-2.853362*	**I(0)**	-3.658754*	**I(0)**
BOVESPA	-3.701563*	**I(0)**	-2.638628*	**I(0)**	-3.731411*	**I(0)**
IPSA	-2.809711*	**I(0)**	-2.657676*	**I(0)**	-3.015778*	**I(0)**
LIGE	-3.077934*	**I(0)**	-5.376735**	**I(1)**	-3.135526*	**I(0)**
CMA	-3.922000*	**I(0)**	-6.624629**	**I(1)**	-4.784799*	**I(0)**
UAEGE	-4.425893*	**I(0)**	-4.070973**	**I(1)**	-4.326805*	**I(0)**
TAALL	-3.128959*	**I(0)**	-2.883429*	**I(0)**	-4.226057*	**I(0)**
TSE50	-2.654076*	**I(0)**	-3.909513**	**I(1)**	-2.965664*	**I(0)**

* MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at level).
** MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at 1st Difference).

Table 4.3
PHILLIPS-PERRON (PP) TEST RESULTS [WITH INTERCEPT AND NO TREND]

Indices	Pre-crisis period – January 2005-June 2007 (30 months)		During-the-crisis period – July 2007-December 2009 (30 months)		Post-crisis period – January 2010-June 2012 (30 months)	
	PP Results	Conclusion	PP Results	Conclusion	PP Results	Conclusion
BOVESPA	-5.460658*	**I(0)**	-3.615622*	**I(0)**	-5.379334*	**I(0)**
RTS	-5.694052*	**I(0)**	-2.792715*	**I(0)**	-5.601888*	**I(0)**
NIFTY	-5.268059*	**I(0)**	-4.605479*	**I(0)**	-6.120434*	**I(0)**
SHCO	-3.614366*	**I(0)**	-5.487391*	**I(0)**	-5.842858*	**I(0)**

NIFTY	-5.268059*	**I(0)**	-4.605479*	**I(0)**	-6.120434*	**I(0)**
K100	-5.772060*	**I(0)**	-4.287639*	**I(0)**	-5.413886*	**I(0)**
CSEALL	-4.888229*	**I(0)**	-3.614517*	**I(0)**	-4.186808*	**I(0)**
DSEGE	-5.952682*	**I(0)**	-4.769205*	**I(0)**	-5.888541*	**I(0)**
ST	-5.232987*	**I(0)**	-3.594474*	**I(0)**	-5.839429*	**I(0)**
JACO	-5.167349*	**I(0)**	-3.594468*	**I(0)**	-6.151512*	**I(0)**
KLSECO	-4.587437*	**I(0)**	-3.931121*	**I(0)**	-5.371430*	**I(0)**
PSECO	-6.056253*	**I(0)**	-4.517574*	**I(0)**	-5.782376*	**I(0)**
DAX30	-5.075863*	**I(0)**	-4.219319*	**I(0)**	-4.810223*	**I(0)**
FTSE100	-6.008166*	**I(0)**	-4.278033*	**I(0)**	-5.608723*	**I(0)**
CAC40	-5.951540*	**I(0)**	-3.793784*	**I(0)**	-4.734679*	**I(0)**
IBEX35	-5.922376*	**I(0)**	-3.704626*	**I(0)**	-5.065133*	**I(0)**
NASDAQCO	-5.860951*	**I(0)**	-3.485279*	**I(0)**	-5.666670*	**I(0)**
TSXCO	-5.865385*	**I(0)**	-3.525708*	**I(0)**	-5.309261*	**I(0)**
IPCALL	-6.479667*	**I(0)**	-4.169000*	**I(0)**	-5.968470*	**I(0)**
MV	-7.021664*	**I(0)**	-3.805950*	**I(0)**	-5.501896*	**I(0)**
BOVESPA	-5.460658*	**I(0)**	-3.615622*	**I(0)**	-5.379334*	**I(0)**
IPSA	-4.311446*	**I(0)**	-3.969329*	**I(0)**	-4.861842*	**I(0)**
LIGE	-5.870505*	**I(0)**	-4.685865*	**I(0)**	-5.236636*	**I(0)**
CMA	-4.239451*	**I(0)**	-3.142586*	**I(0)**	-5.005294*	**I(0)**
UAEGE	-3.917472*	**I(0)**	-3.145549*	**I(0)**	-4.964083*	**I(0)**
TAALL	-4.314015*	**I(0)**	-4.263191*	**I(0)**	-4.469774*	**I(0)**
TSE50	-2.962319*	**I(0)**	-2.720164*	**I(0)**	-3.280358*	**I(0)**

* MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at level).
** MacKinnon critical values for rejection of hypothesis (i.e., $\lambda < 0$) of a unit root (at 1st Difference).

The results in Table 4 have not indicated the presence of a unit-root under PP test results and except in few cases (under ADF test results) in the Panel indices returns series for the overall study period and during all sub-periods. Hence, changes in them are mostly stationary. In other words, all stock market indices returns series are integrated of order zero [i.e., I(0)].

This study uses simple correlation test results and Granger causality test results to find out short-run dynamic linkages and integration, and any possible causal relationships in between these stock markets under different panels in the short-run.

Table 5 presents the concise correlation results for different panels as undertaken in this study.

Table 5.1
CORRELATION RESULTS (OVERALL STUDY PERIOD)

Panels	**Correlations between (coefficient value)**
A (BRIC)	BOVESPA & RTS **(0.801131)**
	BOVESPA & NIFTY **(0.735120)**
	BOVESPA & SHCO **(0.548924)**
	RTS & NIFTY **(0.655425)**

B (SAARC)	**None found**
C (ASEAN)	ST & JACO **(0.799116)**
	ST & KLSECO **(0.743397)**
	ST & PSECO **(0.701244)**
	JACO & KLSECO **(0.740380)**
	JACO & PSECO **(0.692434)**
	KLSECO & PSECO **(0.644939)**
D (EU)	DAX30 & FTSE100 **(0.847872)**
	DAX30 & CAC40 **(0.916938)**
	DAX30 & IBEX35 **(0.729324)**
	FTSE100 & CAC40 **(0.911049)**
	FTSE100 & IBEX35 **(0.769965)**
	CAC40 & IBEX35 **(0.838405)**
E (NAFTA)	NASDAQCO & TSXCO **(0.784414)**
	NASDAQCO & IPCALL **(0.704895)**
	TSXCO & IPCALL **(0.733692)**
F (LAFTA)	MV & BOVESPA **(0.795017)**
	MV & IPSA **(0.597802)**
	MV & LIGE (**0.681575)**
	BOVESPA & IPSA **(0.592096)**
	BOVESPA & LIGE **(0.654395)**
	IPSA & LIGE **(0.504946)**
G (MENA)	UAEGE & TAALL **(0.512306)**

Table 5.2
CORRELATION RESULTS (SUB-PERIODS)

Panels	**Correlations between (coefficient value)**		
	Pre-crisis period – January 2005-June 2007 (30 months)	**During-the-crisis period – July 2007-December 2009 (30 months)**	**Post-crisis period – January 2010-June 2012 (30 months)**
Panel A (BRIC)	BOVESPA & RTS **(0.722155)**	BOVESPA & RTS **(0.844800)**	BOVESPA & RTS **(0.775094)**
		BOVESPA & NIFTY **(0.828077)**	BOVESPA & NIFTY **(0.627257)**

		BOVESPA & SHCO **(0.579062)**	BOVESPA & SHCO **(0.608126)**
	BOVESPA & NIFTY **(0.555005)**	RTS & NIFTY **(0.721581)**	RTS & NIFTY **(0.579608)**
		NIFTY & SHCO **(0.616132)**	RTS & SHCO **(0.530521)**
Panel B (SAARC)	**No Significant Correlations**	NIFTY & CSEALL **(0.535383)**	**No Significant Correlations**
Panel C (ASEAN)	ST & JACO **(0.713008)**	ST & JACO **(0.833661)**	ST & JACO **(0.736360)**
		ST & KLSECO **(0.793406)**	ST & KLSECO **(0.671820)**
		ST & PSECO **(0.771819)**	ST & PSECO **(0.689796)**
	ST & KLSECO **(0.596328)**	JACO & KLSECO **(0.848979)**	JACO & KLSECO **(0.611366)**
		JACO & PSECO **(0.734732)**	JACO & PSECO **(0.803212)**
		KLSECO & PSECO **(0.732713)**	KLSECO & PSECO **(0.596189)**
Panel D (EU)	DAX30 & FTSE100 **(0.824714)**	DAX30 & FTSE100 **(0.899016)**	DAX30 & FTSE100 **(0.764152)**
	DAX30 & CAC40 **(0.924219)**	DAX30 & CAC40 **(0.962479)**	DAX30 & CAC40 **(0.839515)**
	DAX30 & IBEX35 **(0.649861)**	DAX30 & IBEX35 **(0.903680)**	DAX30 & IBEX35 **(0.556863)**
	FTSE100 & CAC40 **(0.858745)**	FTSE100 & CAC40 **(0.936639)**	FTSE100 & CAC40 **(0.885423)**
	FTSE100 & IBEX35 **(0.681538)**	FTSE100 & IBEX35 **(0.844607)**	FTSE100 & IBEX35 **(0.729564)**
	CAC40 & IBEX35 **(0.627871)**	CAC40 & IBEX35 **(0.903542)**	CAC40 & IBEX35 **(0.820793)**
Panel E (NAFTA)	NASDAQCO & TSXCO **(0.593908)**	NASDAQCO & TSXCO **(0.838406)**	NASDAQCO & TSXCO **(0.791398)**
	NASDAQCO & IPCALL **(0.568017)**	NASDAQCO & IPCALL **(0.778893)**	NASDAQCO & IPCALL **(0.747818)**
	TSXCO & IPCALL **(0.670899)**	TSXCO & IPCALL **(0.757465)**	TSXCO & IPCALL **(0.711789)**
Panel F (LAFTA)	MV & BOVESPA **(0.794708)**	MV & BOVESPA **(0.890816)**	MV & BOVESPA **(0.620002)**
		MV & IPSA **(0.725600)**	MV & IPSA **(0.534884)**
		MV & LIGE **(0.866814)**	MV & LIGE **(0.564506)**
		BOVESPA & IPSA **(0.672518)**	BOVESPA & IPSA **(0.578901)**
		BOVESPA & LIGE **(0.782522)**	BOVESPA & LIGE **(0.502080)**
		IPSA & LIGE **(0.634181)**	
Panel G (MENA)	**No Significant Correlations**	CMA & UAEGE **(0.682987)**	UAEGE & TAALL **(0.512649)**
		CMA & TAALL **(0.674162)**	
		UAEGE & TAALL **(0.570495)**	

* Results which show more than **0.500** values are assumed to be significant under this study.

Correlation results for the overall study period are depicted in Table 5.1. Except SAARC (none found) and MENA (only one correlation is present), all other paneled international stock

markets have shown strong relationships during the overall study period. Especially, in ASEAN (Panel C), EU (Panel D) and LAFTA (Panel F) panels, all constituent stock markets are fully inter-related in the short-run. The results show that under all panels during-the-crisis period almost all indices returns series are showing strong correlations. This also mostly true except panel F (i.e., MENA) for the post-crisis period. However, in the pre-crisis period, only panel D (i.e., EU) and E (i.e., NAFTA) are showing strong interrelationships among the selected indices returns. It is also interesting to note that panel B (i.e., SAARC) has not shown any significant correlations in both pre and post-crisis periods. Panel G (i.e., MENA) countries are also not interrelated (except UAE and Saudi Arabia in post-crisis period) during pre and post-crisis periods. All these results imply that there are enough diversification opportunities as available to the regional and international investors in overall and in pre and post-crisis periods, but not in during-the-crisis period.

Table 6 provides the Granger causality test results for this study.

Table 6.1
GRANGER CAUSALITY TEST RESULTS (OVERALL STUDY PERIOD)

Panels	Causal Effect	F-Stat.	Prob.
A (BRIC)	**None found**		
B (SAARC)	**NIFTY→CSEALL**	4.88876	0.0297
	NIFTY→DSEGE	**7.47096**	**0.0076**
	DSEGE→CSEALL	4.96189	0.0286
C (ASEAN)	**ST→KLSECO**	3.83161	0.0536
	ST→PSECO	6.45349	0.0129
	JACO→PSECO	5.85411	0.0177
	KLSECO→PSECO	**9.70813**	**0.0025**
D (EU)	**None found**		
E (NAFTA)	**None found**		
F (LAFTA)	**BOVESPA→IPSA**	5.23615	0.0246
G (MENA)	**TSE50→CMA**	**8.25423**	**0.0052**
	UAEGE→TSE50	4.32219	0.0406

Table 6.1 shows that no short-run Granger causal relationships are present in Panel A (BRIC), D (EU) and E (NAFTA). However, SAARC (Panel B), ASEAN (Panel C) and MENA (Panel G) presents a few unidirectional Granger relationships in the short-run for these regional markets. Especially, the Indian stock market Granger causes the Bangladesh stock market, Malaysian market do the same with the Philippine stock market, and also the Iranian stock market Granger causes the Egyptian market significantly in the short-run during the overall study period.

However, in most of the panels and under different sub-periods, the results suggest no presence of Granger causality in between these international markets returns. There is also no definite trend in these results. However, under some panels and in between some markets unidirectional Granger causality is found under pre, during and

Table 6.2
GRANGER CAUSALITY TEST RESULTS (SUB-PERIODS)

Panels	Pre-crisis period – January 2005-June 2007 (30 months)			During-the-crisis period – July 2007-December 2009 (30 months)			Post-crisis period – January 2010-June 2012 (30 months)		
	Causal Effect	F-Stat.	Prob.	Causal Effect	F-Stat.	Prob.	Causal Effect	F-Stat.	Prob.
A (BRIC)	**None found**			**None found**			**RTS→NIFTY**	**8.01743**	**0.00882**

B (SAARC)	**None found**			**NIFTY→CSEALL**	4.46143	0.04443	**NIFTY→DSEGE**	6.79288	0.01495
				NIFTY→DSEGE	5.23948	0.03045			
				DSEGE→CSEALL	4.71740	0.03917			
C (ASEAN)	**JACO→PSECO**	4.39237	0.04639	**None found**			**KLSECO→JACO**	4.89146	0.03598
D (EU)	**None found**			**None found**			**None found**		
E (NAFTA)	**None found**			**None found**			**None found**		
F (LAFTA)	**None found**			**BOVESPA→MV**	4.67969	0.03990	**MV→LIGE**	5.38302	0.02845
				BOVESPA→IPSA	5.50175	0.02690			
G (MENA)	**None found**			**CMA→UAEGE**	3.98328	0.05653	**TSE50→CMA**	7.08449	0.01394
				CMA→TAALL	6.28069	0.01879			
				CMA→TSE50	4.69536	0.03959			
				UAEGE→TSE50	9.34908	**0.00511**			
				TSE50→TAALL	4.32294	0.04761			
				TAALL→TSE50	6.17841	0.01969			

post-crisis periods. The results show that only the Indonesian stock market Granger causes the Philippines market in the pre-crisis period among all panels. In the post-crisis period, the Russian market Granger causes the Indian market (under Panel A), NIFTY (i.e., the Indian stock market) has an unidirectional causality with the Bangladesh stock market under Panel B, the Malaysian stock market Granger causes JACO under Panel C, under Panel F the Argentine market Granger causes LIGE, and also Iranian TSE50 Index returns has an unidirectional causality with the Egyptian market under Panel G. During-the-crisis period results also find no Granger causality under Panel A, C, D and E. However, under SAARC panel, it is found that the Indian stock market has an unidirectional Granger causal relationships with both Bangladesh and Sri Lankan stock markets. Also, DSEGE Granger causes the Sri Lankan stock market returns. Under Panel F (i.e., LAFTA), the Brazilian stock market Granger causes both Argentine and Chilean stock markets.

But, most significantly this study finds that MENA markets are most dynamically linked during-the-crisis period. The Egyptian market Granger causes all other markets also. Also, though not significant fully, but TSE50 and TAALL indices returns do bear a bidirectional causality in this crisis period. However, it is to be noted here that only RTS to NIFTY and UAEGE to TSE50 show significant Granger causality relationships under this study. All these results overall contradict the overwhelming relationships as found in earlier correlation results.

After an in-depth study to find short-run relationships and dynamic linkages among the stock markets under all these panels, this study reveals the long-run integration in between these markets. Here, one lag length has been selected on the basis of either AIC or SIC.

Under the JJ tests, test statistics are calculated allowing for an intercept and no trend term in the co-integrating equation (CE) and no intercept in VAR.

The results of the Johansen and Juselius's Trace test and Max-Eigenvalue tests are shown in Table 7.For the overall study period, Table 7.1 results show that all these regional or economic-status based international stock markets under all panels are strongly integrated in the long-run. This is because 3/4 co-integration equations are present under both Trace and maximum eigenvalue tests for all trade-agreement (mostly regional) or economic-status based

panels. Thus, there is no scope for international portfolio diversification for the international investors in such region-based markets. However, different results show different numbers of co-integrating long-run integration among the paneled international stock markets under pre, during and post-crisis periods. In case of BRIC stock markets, both trace and maximum eigenvalue tests results indicate one long-term integration relationship during-the-crisis period. However, post-crisis period trace result indicates higher co-integration among these markets. This is quite similar to SAARC markets where post-crisis period trace results show 3 and 2 co-integrating equations at the 5% and 1% level respectively. However, maximum eigenvalue test statistic only indicates 1 such co-integration. Pre and during-the-crisis results under both these panels show lesser long-run relationships than the post-crisis period. Panel C results for the ASEAN stock markets are a bit different. The Panel results show that all these markets are co-integrated post-crisis as per trace results, though this is not supported by maximum eigenvalue test. Pre-crisis period for these markets also show integration evidence and during-the-crisis only 1 co-integration equation is present under both test values. The EU markets are showing exceptional co-integration in the long-run under all these periods. Especially during-the-crisis and post-crisis period trace test results show strong evidence of long-run integration among these markets. The NAFTA (see Panel F) stock markets are also integrated in the long-run under both pre and post-crisis periods.

Table 7.1
JJ COINTEGRATION TEST RESULTS (OVERALL STUDY PERIOD)

Panels	Likelihood Ratio (Trace) Test for Cointegrating Rank					Max-Eigenvalue Test for Cointegrating Rank				
	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 % Critical Value	1 % Critical Value	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 % Critical Value	1 % Critical Value
A (BRIC)	None **	0.510343	151.1863	53.12	60.16	None **	0.510343	62.12228	28.14	33.24
	At most 1 **	0.369896	89.06406	34.91	41.07	At most 1 **	0.369896	40.18268	22.00	26.81
	At most 2 **	0.297267	48.88137	19.96	24.60	At most 2 **	0.297267	30.69166	15.67	20.20
	At most 3 **	0.188667	18.18971	9.24	12.97	At most 3 **	0.188667	18.18971	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				
B (SAARC)	None **	0.555403	169.4545	53.12	60.16	None **	0.555403	70.52104	28.14	33.24
	At most 1 **	0.425877	98.93349	34.91	41.07	At most 1 **	0.425877	48.27729	22.00	26.81
	At most 2 **	0.326944	50.65620	19.96	24.60	At most 2 **	0.326944	34.44563	15.67	20.20
	At most 3 **	0.169999	16.21058	9.24	12.97	At most 3 **	0.169999	16.21058	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				
C (ASEAN)	None **	0.465069	164.0329	53.12	60.16	None **	0.465069	54.42871	28.14	33.24
	At most 1 **	0.451613	109.6042	34.91	41.07	At most 1 **	0.451613	52.26735	22.00	26.81
	At most 2 **	0.332204	57.33688	19.96	24.60	At most 2 **	0.332204	35.12817	15.67	20.20
	At most 3 **	0.225295	22.20871	9.24	12.97	At most 3 **	0.225295	22.20871	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				
D (EU)	None **	0.485840	175.7641	53.12	60.16	None **	0.485840	57.87429	28.14	33.24
	At most 1 **	0.403598	117.8898	34.91	41.07	At most 1 **	0.403598	44.96507	22.00	26.81
	At most 2 **	0.363137	72.92475	19.96	24.60	At most 2 **	0.363137	39.25447	15.67	20.20
	At most 3 **	0.320919	33.67028	9.24	12.97	At most 3 **	0.320919	33.67028	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				
E (NAFTA)	None **	0.475072	124.4766	34.91	41.07	None **	0.475072	56.07106	22.00	26.81
	At most 1 **	0.402047	68.40553	19.96	24.60	At most 1 **	0.402047	44.73918	15.67	20.20
	At most 2 **	0.238166	23.66635	9.24	12.97	At most 2 **	0.238166	23.66635	9.24	12.97
	Trace test indicates 3 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 3 cointegrating equation(s) at both 5% and 1% levels				
F (LAFTA)	None **	0.395685	122.3714	53.12	60.16	None **	0.395685	43.81841	28.14	33.24
	At most 1 **	0.328615	78.55301	34.91	41.07	At most 1 **	0.328615	34.66185	22.00	26.81
	At most 2 **	0.286785	43.89116	19.96	24.60	At most 2 **	0.286785	29.40364	15.67	20.20
	At most 3 **	0.153397	14.48752	9.24	12.97	At most 3 **	0.153397	14.48752	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				
G (MENA)	None **	0.499283	154.2781	53.12	60.16	None **	0.499283	57.41221	28.14	33.24

	At most 1 **	0.476074	96.86587	34.91	41.07	At most 1 **	0.476074	53.65156	22.00	26.81
	At most 2 **	0.273954	43.21432	19.96	24.60	At most 2 **	0.273954	26.57176	15.67	20.20
	At most 3 **	0.181689	16.64256	9.24	12.97	At most 3 **	0.181689	16.64256	9.24	12.97
	Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 4 cointegrating equation(s) at both 5% and 1% levels				

Table 7.2
JJ COINTEGRATION TEST RESULTS (SUB-PERIODS)

Panels	Period	Likelihood Ratio (Trace) Test for Cointegrating Rank					Max-Eigenvalue Test for Cointegrating Rank				
		Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 % Critical Value	1 % Critical Value	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 % Critical Value	1 % Critical Value
A (BRIC)	Pre-crisis	None *	0.615073	58.88714	53.12	60.16	None	0.615073	25.77692	28.14	33.24
		At most 1	0.451285	33.11022	34.91	41.07	At most 1	0.451285	16.20477	22.00	26.81
		At most 2	0.315223	16.90545	19.96	24.60	At most 2	0.315223	10.22387	15.67	20.20
		At most 3	0.219223	6.681580	9.24	12.97	At most 3	0.219223	6.681580	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level					Max-eigenvalue test indicates no cointegration at both 5% and 1% levels				
	During-the-crisis	None **	0.837481	84.73493	53.12	60.16	None **	0.837481	50.87491	28.14	33.24
		At most 1	0.458946	33.86002	34.91	41.07	At most 1	0.458946	17.19862	22.00	26.81
		At most 2	0.338152	16.66140	19.96	24.60	At most 2	0.338152	11.55616	15.67	20.20
		At most 3	0.166674	5.105240	9.24	12.97	At most 3	0.166674	5.105240	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels				
	Post-crisis	None *	0.660855	66.24751	54.07904		None *	0.660855	30.27716	28.58808	
		At most 1 *	0.443089	35.97035	35.19275		At most 1	0.443089	16.38979	22.29962	
		At most 2	0.396347	19.58056	20.26184		At most 2	0.396347	14.13318	15.89210	
		At most 3	0.176795	5.447385	9.164546		At most 3	0.176795	5.447385	9.164546	
		Trace test indicates 2 cointegrating equation(s) at the 0.05 level					Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level				
B (SAARC)	Pre-crisis	None **	0.634175	64.25412	53.12	60.16	None	0.634175	27.15123	28.14	33.24
		At most 1	0.52745	37.10	34.91	41.07	At most 1	0.52745	20.23	22.00	26.81

		*	4	289				4	974		
		At most 2	0.32958 7	16.86 315	19.96	24.60	At most 2	0.32958 7	10.79 625	15.67	20.20
		At most 3	0.20124 4	6.066 900	9.24	12.97	At most 3	0.20124 4	6.066 900	9.24	12.97
		Trace test indicates 2 cointegrating equation(s) at the 5% level and1 cointegrating equation(s) at the 1% level					Max-eigenvalue test indicates no cointegration at both 5% and 1% levels				
	During-the-crisis	None **	0.68531 4	60.88 339	53.12	60.16	None *	0.68531 4	32.37 302	28.14	33.24
		At most 1	0.41866 8	28.51 037	34.91	41.07	At most 1	0.41866 8	15.18 815	22.00	26.81
		At most 2	0.31442 6	13.32 222	19.96	24.60	At most 2	0.31442 6	10.56 997	15.67	20.20
		At most 3	0.09361 8	2.752 255	9.24	12.97	At most 3	0.09361 8	2.752 255	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level				
	Post-crisis	None **	0.76281 7	85.00 713	53.12	60.16	None **	0.76281 7	40.28 985	28.14	33.24
		At most 1 **	0.53845 1	44.71 728	34.91	41.07	At most 1	0.53845 1	21.64 866	22.00	26.81
		At most 2 *	0.47948 1	23.06 862	19.96	24.60	At most 2 *	0.47948 1	18.28 201	15.67	20.20
		At most 3	0.15713 7	4.786 609	9.24	12.97	At most 3	0.15713 7	4.786 609	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at the 5% level and 2 cointegrating equation(s) at the 1% level					Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels				
C (ASEAN)	Pre-crisis	None **	0.73738 3	71.23 282	53.12	60.16	None **	0.73738 3	36.10 060	28.14	33.24
		At most 1 *	0.45980 4	35.13 222	34.91	41.07	At most 1	0.45980 4	16.62 723	22.00	26.81
		At most 2	0.36145 3	18.50 499	19.96	24.60	At most 2	0.36145 3	12.11 111	15.67	20.20
		At most 3	0.21085 9	6.393 883	9.24	12.97	At most 3	0.21085 9	6.393 883	9.24	12.97
		Trace test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level					Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels				
	During-the-crisis	None **	0.69396 0	64.96 197	53.12	60.16	None *	0.69396 0	33.15 314	28.14	33.24
		At most 1	0.43035 9	31.80 883	34.91	41.07	At most 1	0.43035 9	15.75 699	22.00	26.81
		At most 2	0.28609 0	16.05 184	19.96	24.60	At most 2	0.28609 0	9.435 974	15.67	20.20
		At most 3	0.21044 1	6.615 865	9.24	12.97	At most 3	0.21044 1	6.615 865	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels					Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level				
	Post-crisis	None **	0.61645 5	83.49 880	53.12	60.16	None	0.61645 5	26.83 237	28.14	33.24
		At most 1 **	0.58129 2	56.66 644	34.91	41.07	At most 1 *	0.58129 2	24.37 630	22.00	26.81
		At most 2 **	0.49527 4	32.29 013	19.96	24.60	At most 2 *	0.49527 4	19.14 469	15.67	20.20
		At most 3 **	0.37467 3	13.14 544	9.24	12.97	At most 3 **	0.37467 3	13.14 544	9.24	12.97

		Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels					**Max-eigenvalue test indicates no cointegration at both 5% and 1% levels**				
D (EU)	**Pre-crisis**	**None ****	0.793660	81.13482	53.12	60.16	**None ****	0.793660	42.61222	28.14	33.24
		At most 1 *	0.578443	38.52260	34.91	41.07	**At most 1 ***	0.578443	23.32263	22.00	26.81
		At most 2	0.305936	15.19997	19.96	24.60	**At most 2**	0.305936	9.860179	15.67	20.20
		At most 3	0.179441	5.339788	9.24	12.97	**At most 3**	0.179441	5.339788	9.24	12.97
		Trace test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level**				
	During-the-crisis	**None ****	0.626617	69.83164	53.12	60.16	**None**	0.626617	27.58418	28.14	33.24
		At most 1 **	0.475623	42.24746	34.91	41.07	**At most 1**	0.475623	18.07525	22.00	26.81
		At most 2 *	0.416321	24.17221	19.96	24.60	**At most 2**	0.416321	15.07533	15.67	20.20
		At most 3	0.277392	9.096879	9.24	12.97	**At most 3**	0.277392	9.096879	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at the 5% level and 2 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates no cointegration at both 5% and 1% levels**				
	Post-crisis	**None ****	0.630498	77.07990	53.12	60.16	**None**	0.630498	27.87681	28.14	33.24
		At most 1 **	0.599111	49.20309	34.91	41.07	**At most 1 ***	0.599111	25.59401	22.00	26.81
		At most 2 *	0.424124	23.60908	19.96	24.60	**At most 2**	0.424124	15.45216	15.67	20.20
		At most 3	0.252723	8.156928	9.24	12.97	**At most 3**	0.252723	8.156928	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at the 5% level and 2 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates no cointegration at both 5% and 1% levels**				
E (NAFTA)	**Pre-crisis**	**None ****	0.719463	62.59767	34.91	41.07	**None ****	0.719463	34.31830	22.00	26.81
		At most 1 **	0.473867	28.27938	19.96	24.60	**At most 1 ***	0.473867	17.33946	15.67	20.20
		At most 2 *	0.333145	10.93992	9.24	12.97	**At most 2 ***	0.333145	10.93992	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at the 5% level and 2 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates 3 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level**				
	During-the-crisis	**None ****	0.509828	44.70027	34.91	41.07	**None**	0.509828	19.96399	22.00	26.81
		At most 1 **	0.478829	24.73627	19.96	24.60	**At most 1 ***	0.478829	18.24694	15.67	20.20
		At most 2	0.206865	6.489335	9.24	12.97	**At most 2**	0.206865	6.489335	9.24	12.97
		Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels					**Max-eigenvalue test indicates no cointegration at both 5% and 1% levels**				
	Post-crisis	**None ****	0.599840	54.70247	34.91	41.07	**None ***	0.599840	25.64493	22.00	26.81
		At most 1 **	0.489324	29.05754	19.96	24.60	**At most 1 ***	0.489324	18.81655	15.67	20.20
		At most 2 *	0.306324	10.24099	9.24	12.97	**At most 2 ***	0.306324	10.24099	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at					**Max-eigenvalue test indicates 3 cointegrating**				

		the 5% level and 2 cointegrating equation(s) at the 1% level					**equation(s) at the 5% level and no cointegration at the 1% level**				
F (LAFTA)	**Pre-crisis**	**None**	0.651788	47.81042	53.12	60.16	**None ***	0.651788	28.48348	28.14	33.24
		At most 1	0.298225	19.32694	34.91	41.07	**At most 1**	0.298225	9.561849	22.00	26.81
		At most 2	0.174132	9.765090	19.96	24.60	**At most 2**	0.174132	5.165656	15.67	20.20
		At most 3	0.156630	4.599433	9.24	12.97	**At most 3**	0.156630	4.599433	9.24	12.97
		Trace test indicates no cointegration at both 5% and 1% levels					**Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level**				
	During-the-crisis	**None ****	0.688204	60.85641	53.12	60.16	**None ***	0.688204	32.63137	28.14	33.24
		At most 1	0.413029	28.22504	34.91	41.07	**At most 1**	0.413029	14.91783	22.00	26.81
		At most 2	0.280387	13.30721	19.96	24.60	**At most 2**	0.280387	9.213158	15.67	20.20
		At most 3	0.136029	4.094052	9.24	12.97	**At most 3**	0.136029	4.094052	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels					**Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level**				
	Post-crisis	**None ****	0.705735	71.78051	53.12	60.16	**None ****	0.705735	34.25173	28.14	33.24
		At most 1 *	0.465826	37.52879	34.91	41.07	**At most 1**	0.465826	17.55695	22.00	26.81
		At most 2 *	0.362183	19.97184	19.96	24.60	**At most 2**	0.362183	12.59172	15.67	20.20
		At most 3	0.231701	7.380124	9.24	12.97	**At most 3**	0.231701	7.380124	9.24	12.97
		Trace test indicates 3 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels**				
G (MENA)	**Pre-crisis**	**None ****	0.675174	66.74958	53.12	60.16	**None ***	0.675174	30.36059	28.14	33.24
		At most 1 *	0.501754	36.38899	34.91	41.07	**At most 1**	0.501754	18.80988	22.00	26.81
		At most 2	0.283624	17.57911	19.96	24.60	**At most 2**	0.283624	9.005872	15.67	20.20
		At most 3	0.272053	8.573240	9.24	12.97	**At most 3**	0.272053	8.573240	9.24	12.97
		Trace test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level					**Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level**				
	During-the-crisis	**None ****	0.732373	62.72922	53.12	60.16	**None ****	0.732373	36.90856	28.14	33.24
		At most 1	0.405000	25.82066	34.91	41.07	**At most 1**	0.405000	14.53742	22.00	26.81
		At most 2	0.195038	11.28325	19.96	24.60	**At most 2**	0.195038	6.074894	15.67	20.20
		At most 3	0.169737	5.208352	9.24	12.97	**At most 3**	0.169737	5.208352	9.24	12.97
		Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels					**Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels**				
	Post-crisis	**None ****	0.621117	63.30904	53.12	60.16	**None**	0.621117	23.29267	28.14	33.24
		At most 1	0.47966	40.01	34.91	41.07	**At most 1**	0.47966	15.67	22.00	26.81

		*	0	636				0	857		
		At most 2 *	0.452635	24.33780	19.96	24.60	At most 2	0.452635	14.46337	15.67	20.20
		At most 3 *	0.337301	9.874431	9.24	12.97	At most 3 *	0.337301	9.874431	9.24	12.97
		Trace test indicates 4 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level					Max-eigenvalue test indicates no cointegration at both 5% and 1% levels				
*(**) denotes rejection of the hypothesis at the 5%(1%) level											

However, during-the-crisis period only trace test shows 2 co-integration equations are present among them. In case of LAFTA markets also, long-term co-integrating relationships are evident especially in the during and post-crisis period. Panel G (i.e., MENA) markets also show such long-run integration, however most unanimously in the pre and during-the-crisis period. But, Trace test results also are evident of all-round integration in the post-crisis period for these stock markets.

Thus, it is quite evident that it is extremely difficult for the international investors to find disintegrated international especially regional stock markets to bank upon during any period in the long-run to avail the opportunity of portfolio diversification for maximizing their returns. Also, in comparison to other paneled markets BRIC (i.e., Panel A) and LAFTA (i.e., Panel F) are better suited for international investors especially in the pre and during-the-crisis periods. In the post-crisis period, it is proved that portfolio diversification is practically non-existent in nature.

CONCLUSION

This study has investigated the integration and dynamic linkages of the trade agreement and economic-status based 27 international stock markets in light with the US subprime crisis during 2007-09. One of the more specific objectives was also to find the most favourable portfolio diversification opportunity available before the international investors among these paneled regional markets. To do an in-depth study, it divides the overall study period in to pre, during and post-crisis periods by using the monthly returns for all these indices.

The graphs and descriptive statistics results have pointed out non-normality and volatility of the paneled indices returns series. Thus, the ADF and PP tests are conducted. These results however mostly point out that the data series are stationary at level [i.e., I(0)]. Based on these results, short-run relationships and dynamic linkages are found by using correlation tests results and Granger causality tests results. Correlation tests results mostly indicate significant relationships in between the international markets under different panels under the overall study period (except SAARC and MENA panels), post-crisis (except MENA markets) and during-the-crisis periods. However, in the pre-crisis period, only EU and NAFTA panels are showing strong interrelationships among the selected indices returns. All these results imply that there are few diversification opportunities as available such as SAARC and MENA stock markets to the regional and international investors in overall and in pre and post-crisis periods, but not in during-the-crisis period.

The Granger causality tests results have also found many unidirectional, but no bidirectional causal relationships in between these paneled markets during the overall study period and different sub-periods. For the overall study period, one short-run significant Granger relationship is found for each in the SAARC (i.e., the Indian stock market Granger causes the Bangladesh stock market) Panel, ASEAN (i.e., the Malaysian market do the same with the Philippine stock market), and also in the MENA (i.e., the Iranian stock market Granger causes

the Egyptian market) Panel. Also, under some panels and in between some markets unidirectional Granger causality is found under pre, during and post-crisis periods. But, most significantly this study finds that MENA markets are most dynamically linked during-the-crisis period. However, it is to be noted here that only RTS to NIFTY and UAEGE to TSE50 show significant Granger causality relationships under this study. Overall, all these results contradict the overwhelming short-run relationships as found in earlier correlation results.

In the long-run, JJ co-integration test results show strong co-integration relationships in between all these markets for the overall study period under all panels. Thus, there is no scope for international portfolio diversification for the international investors in such region-based or economic-status based markets.

However, under pre, during and post-crisis periods contradictory results are found as shown by different numbers of co-integrating long-run integrations among the paneled international stock markets.

On an overall basis, I can conclude that in comparison to other paneled markets BRIC (i.e., Panel A) and LAFTA (i.e., Panel F) are better suited for international investors especially in the pre and during-the-crisis periods. In the post-crisis period, it is proved that portfolio diversification is practically non-existent in nature.

However, this study is not free from limitations. It didn't take into consideration the impact of very recent European debt crisis that caused havoc throughout the world during this study period. Also, the application of price-based measure to measure international stock markets integration is a limiting factor for this study. There are serious practical problems in using prices to measure global or regional integration, particularly in emerging markets. This is because prices may move together because of a common external factor or because of similar macroeconomic fundamentals, and not because of market integration. Moreover, prices may be affected by differences in currency, credit and liquidity risks, implying different price movements even if there is a substantial degree of financial integration (Prasad et al., 2006).

Thus, future studies should also take into consideration the above limitations with the application of advanced methodologies. Also, macroeconomic analysis should be included in these kinds of studies to make the results more authentic and reliable.

REFERENCES

Bekaert G, Harvey CR & Lumsdaine RL (2002) Dating the integration of the world equity markets. *Journal of Financial Economics*, *65*, 203-247.

Brooks C (2002) *Introductory Econometrics for Finance* (*1st Ed.*) London: Cambridge University Press.

Dasgupta R (2013) India's Integration and Dynamic Linkages with World Emerging Economies and the US - Opportunities for Portfolio Diversification. *International Research Journal of Finance and Economics*, (117*)*,225-245.

Dickey DA & Fuller WA (1979) Distributions of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association*,*74*(366),427-481.

Dickey DA & Fuller WA (1981) Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*,*49*,1057-1072.

Frijns B, Tourani-Rad A & Indriawan I (2012) Political Crises and the Stock Markets Integration of Emerging Markets. *Journal of Banking and Finance*, *36*, 644-653.

Gokay, B. (2009, February). The 2008 World Economic Crisis: Global Shifts and Faultiness. *Global Research.*

Graham M, Kiviaho J & Nikkinen J (2012) Integration of 22 Emerging Stock Markets: A Three-Dimensional Analysis. *Global Finance Journal*, *23*,34-47.

Granger CWJ (1969) Investigating Causal Relationships by Econometric Models and Cross Spectral Methods. *Econometrica*,*37*,425-435.

Hooy C-W & Goh K-L (2007) The Determinants of Stock Market Integration: A Panel Data Investigation. *Proceedings of the 15th Annual Conference on Pacific Basin Finance, Economics, Accounting and Management,* 1-32.

International Monetary Fund (IMF) (2009) *Regional Economic Outlook (Asia and Pacific).*

Johansen S & Juselius K (1990) Maximum Likelihood Estimation and Inference on Cointegration-With Applications to the Demand For Money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169-210.

Karolyi GA & Stultz RM (1996) Why do markets move together? An investigation of US-Japan stock return comovement. *Journal of Finance*, *51*,951-986.

Lin WL, Engle RF & Ito T (1994) Do bulls and bears move across borders? International transmission of stock returns and volatility. *The Review of Financial Studies*,*7*,507-538.

Longin F & Solnik B (1995) Is the correlation in international equity returns constant: 1960-1990? *Journal of International Money and Finance*, *14*(1),3-26.

Longin F & Solnik B (2001) Extreme correlations of international equity markets. *Journal of Finance*, *56*(2), 649-676.

Phillips PCB & Perron P (1988) Testing for a Unit Root in Time Series Regression. *Biometrika*, 75(2),335-346.

Prasad E, Rajan R & Subramanian A (2006) Patterns of international capital flows and their implications for economic development. *Proceedings of the symposium, 'The New Economic Geography: Effects and Policy Implications'*.

Ratanapakorn O & Sharma SC (2002) Interrelationships among Regional Stock Indices. *Review of Financial Economics*, *11*, 91-108.

BRINGING ACTIVE LEARNING INTO HIGH SCHOOL ECONOMICS: SOME EXAMPLES FROM THE SIMPSONS

Joshua C. Hall, West Virginia University
Alex Peck, Webster-Schroeder High School
Marta Podemska-Mikluch, Gustavus Adolphus College

ABSTRACT

In this brief educational note, we provide several examples of directed classroom activities for the high school economics classroom using the long-running television show The Simpsons. In doing so, we provide an overview of the scholarly literature on using popular culture to teach economics. Our examples highlight how popular culture can be successfully employed at the secondary level to engage and teach students through active learning. We conclude with some thoughts for secondary social studies teachers looking to enhance economic instruction.

INTRODUCTION

Scholars have long been interested in economic education at the high school level (Walstad and Soper 1988; Becker et al. 1990). In recent years a number of great background resources have been developed for high school teachers of economics. For example, the edited volume by Schug and Wood (2011) provide a number of ways to make economics "cool in school." Similarly, Schug et al. (2015) provide three important episodes in American economic history that secondary social studies teachers can use to teach costs, incentives, and the economic way of thinking. The availability of scholarship like this has allowed high school social studies teachers to enhance their economic instruction and provide students with a better contextual understanding of the historical development of the U.S. economy.

Sometimes, however, it is better to teach economic concepts disengaged from real-world situations (Gillis and Hall 2010). While there are many pedagogical reasons for moving away from history or current events, an important reason is that student engagement is necessary for successful learning and one way to arouse engagement is by using references to culture and multimedia in the classroom. These references play a role of storytelling and storytelling has been recognized as a great tool for helping students connect the new material to what they already know (Salemi 2002; Barkley 2009; Heath and Heath 2007; Gottschall 2012; Brown and McDaniel 2014).

There are additional benefits to using references to culture and multimedia. First, as shown by cognitive and neuroscience literature, using examples from creative arts facilitates activation of neurological pathways that support the transfer of information from short- to long-term memory (Davis 2015). In this regard, using *The Simpsons* in the economics classroom has been shown to have a positive impact on student learning, especially for students on the lower end of grade distribution (Chu 2014). Second, using multimedia in the classroom makes our profession more approachable, it helps "rectify the image of economics" (Geerling 2012) in the minds of students.

In this brief educational note, we provide an overview of the scholarly literature on using popular culture to teach economics. While this literature has primarily been focused on the college level, we feel that it can be successfully employed at the secondary level to engage and teach students through active learning. We then provide several examples of directed or supported classroom activities utilizing examples from the long-running television show *The Simpsons*. We then conclude with some thoughts for secondary social studies teachers looking to enhance their economic instruction.

POPULAR CULTURE AND ACTIVE LEARNING

At first economists lagged in adopting new engagement techniques and instead relied heavily on conventional methods such as "chalk and talk" (Becker and Watts 1995; Becker and Watts 1996; Becker 1997; Becker and Watts 2001; Watts and Becker 2008). However, in the recent years, economists begun to design and experiment with a variety of diverse engagement techniques. For example, many suggest using various collections of TV and movie clips to illustrate basic economic concepts in principles classes (Leet and Houser 2003; Mateer 2004; Mateer, Ghent, and Stone 2011) and more advanced concepts in upper level courses (Dixit 2005; Diamond 2009; Mateer and Stephenson 2011). In contrast to relying on collections of illustrations from multiple sources, other authors suggest building the classroom experience around one source of examples. *The Simpsons* are among the most popular sources (Hall 2005; Gillis and Hall 2010; Luccasen and Thomas 2010; Hall 2014), followed by the Harry Potter movies and book series (Podemska-Mikluch and Deyo 2014; Podemska-Mikluch, Deyo, and Mitchell 2015), Seinfeld (Ghent, Grant, and Lesica 2011; Dixit 2012) and The Drew Carey Show (Holian 2011).

While clips from popular movies and TV shows occupy a prominent place in the economic education literature, innovative engagement techniques are not limited to the usage of clips (Ferrarini 2012). Authors also recommend using such atypical tools as comic strips, music, and podcasts (Lawson 2006; Lawson, Hall, and Mateer 2008; Hall 2012; Van Horn and Van Horn 2013; Luther 2015) as well as encouraging students to become producers of economic content in their first economic course (Hall and Podemska-Mikluch 2015).

The publication of the edited volume *Homer Economicus: The Simpsons and Economics* (Hall 2014), combined with its longevity and breadth, make The Simpsons an ideal show for high school teachers to use in their classrooms to enhance understanding of some basic economic concepts. The following examples were developed and used in a large comprehensive high school in the state of New York where economics is a requirement for graduation and is a half-year course. The class size was 23 students, although these activities could be used in smaller classes and classes up to 40 students.

ASSIGNMENTS APPROPRIATE FOR THE SECONDARY CLASSROOM

In this section we present information on several structured assignments using The Simpsons television show. Information is provided on the economic concepts that are being highlighted, The Simpsons episodes used, and the details of the assignment so that other instructors might adapt them to their own use. All of these activities were used during class time towards the end of the semester. These activities coincided with students learning about prices in a market economy. The students had previously learned about the laws of supply and demand and the focus of this section and activities was to be able to synthesize that knowledge so that

they better understood prices and how they are determined by manufacturers, stores etc. The clips, coupled with the accompanied questions also covered the topics of excess supply and finding market equilibrium. With supply and demand and market coordination under their belt, we were able to move on to other related topics in markets.

Prices, Markets Equilibrium, and Excess Supply

Episode Used: "Bart Gets an Elephant" and "Oh Brother, Where Art Thou?"

Students watched the portion of the episode in which Bart receives the elephant and the family's initial response to having Stampy the Elephant, which included setting prices to see/ride the elephant. We stopped watching the clip right after Homer adjusted his prices after Marge informed him how much it actually cost to take care of an elephant. In the second episode we watched about the last five minutes of the episode which included Homer designing "The Homer" and the unveiling of the car and its price. The clip was stopped as Herb Powell sees his car company being sold to a Japanese company due to the failure of "The Homer"

Activity: The students worked independently to answer questions 1-3 before we watched the episode. As a class we then discussed their answers. After the discussion I played the episodes and students answered the next set of questions. We discussed them as a class and students handed in their responses for a grade.

Chapter Preview Activity

EQ: How do you know when the price is "right"?

Think of a product you recently purchased. On a scrap sheet of paper or in your notes, record the name of the product and the approximate price you paid. Then answer these questions.

1 *What are some reasons you were willing to buy the product at this price?*
2 *What are some reasons the seller was willing to sell the product at this price?*
3 *Do you think you paid the "right" price for this product? Why or why not?*

Pricing & The Simpsons – As you watch the clips think about the following questions.

1 *What are some reasons why the citizens of Springfield were willing to pay Homer's prices?*
2 *What are some reasons that Homer was willing to charge these prices?*
3 *Do you think people paid the "right" price for the services? Why or Why not?*
4 *Why does Homer change his prices? What affect does that have on the consumers?*
5 *Do people have the right to be upset when he raises his prices? Why or Why not?*
6 *After watching both clips from The Simpsons, describe the state of the market in each episode. Support your claim with evidence from the episodes and your text.*
7 *After watching both clips from The Simpsons, describe what type of excess each producer is facing. Why is that? How can they fix it?*

Behavioral Economics – Nudging and Framing

Episode Used: "Homer and Apu" and "The Class Struggle in Springfield"

The class watches the first ten minutes of "Homer and Apu" as Apu's business practices running the Kwik E Mart etc. are examples of nudging. The episode is stopped right after Apu put the corn cans on the counter, which increased Bart and Lisa's demand for corn. "The Class Struggle in Springfield" is watched from the beginning until Marge decides to buy a Chanel dress because of its deeply discounted price.

Activity: In class the previous day we discussed why stores are laid out the way they are (i.e. grocery stores have the milk all the way in the back of the store). Prior to watching the episode, the students completed the right hand side of the chart and we discussed their examples.

Behavioral Economics Mini Lesson

Nudges & Framing

Nudge theory is a concept in behavioral science, political theory and economics that argues that positive reinforcement and indirect suggestions to try to achieve non-forced compliance can influence the motives, incentives and decision making of groups and individuals, at least as effectively - if not more. Framing theory and the concept of framing bias suggests that how something is presented (the "frame") influences the choices people make.

Table 1
NUDGE

Examples from The Simpsons	Examples from the real world

Table 2
FRAMING

Examples from The Simpsons	Examples from the real world

Self Interest

Episode Used: "Marge, the Gamer"

In class, the entire episode could be watched as all the storylines could be related to self-interest. For example, Homer learns the rules of the game to be a better referee, while Lisa gets Homer to be a bad referee that calls things in her favor.

Activity: Before watching the episode, students answer questions one and two and then discussed them as a class. The instructor should specifically go over the definition of self-interest before watching the episode so it is fresh in the minds of students as they watch the show and think about Question 3. As a follow-up, students wrote a short paper using the prompts provided. Encouragement was given to use examples from The Simpsons to support their arguments.

Markets and Self-Interest

1 *A market is an arrangement that allows buyers and sellers to exchange things. Why do markets exist?*
2 *What comes to mind when you hear the term self-interest?*
3 *Watch the clip from The Simpsons. What connection can you make between the clip and economics?*

HW Assignment – Self-Interest
Definitions: Self-interest – One's own personal gain
Competition – The struggle among producers for the dollars of consumers

Think about what you plan to do after high school graduation. Will you get a job, go to college, enlist in the military, travel, or start your own business? After thinking for a few minutes, answer the questions below on a separate sheet of paper.

Paragraph #1 – Write a paragraph about how your choices are motivated by self-interest.

Paragraph #2 Think about the specifics of your choices. Which college? Where will you travel? What kind of job or business? Explain how these choices are also motivated by self-interest.

Paragraph #3 Explain how your self-interest might also be affected by competition.

Economics of Real Life – Legalization of Gambling

Episode Used: "$pringfield (or, How I Learned to Stop Worrying and Love Legalized Gambling)"

The entire episode is on the topic of the economics of the legalization of gambling so the full episode was watched in class.

Activity: The students were given three articles on the legalization of gambling to read to fill in the left hand portion of the below charts. The first was a local article from a newspaper on the legalization of gambling. The second article was the article from the Los Angeles Times that inspired the writers of The Simpsons to write the $pringfield episode (Booth 1992). The third article provided was a journal article discussing the proliferation of Indian casinos over the past decade (Swift 2014). The articles were read for homework and we discussed them as a class before watching the episode. Afterwards, the students wrote a 1-2 page position paper on the topic of legalized gambling and whether they supported a casino being built in town.

Economics in Real Life Case Study

The Economics of Casino Gambling

Directions: Read the articles handed out in class. As you read, write down evidence that is related to the economic benefits and costs of casino legalization. Make sure that the evidence collected relates to the criteria given. After you have finished reading we will watch an episode of The Simpsons that addresses the issue of casino gambling. Complete your chart with evidence from the episode.

Before reading & viewing: Do you agree or disagree with the legalization of gambling/casinos? Support your claim.

Table 3
ECONOMIC BENEFITS FROM CASINO LEGALIZATION

Economic Benefit	Examples from Articles	Examples from *The Simpsons* episode
Tax Revenues		
Employment		
Consumer Choice & Increased Variety		

Table 4
ECONOMIC AND SOCIAL COSTS FROM CASINOS

Economic/Social Costs	Examples from Articles	Examples from *The Simpsons* episode

Moral Objections to Gambling		
Industry Cannibalization		
Crime		
Negative Externalities & Problem Gambling		

After reading & viewing: Do you agree or disagree with the legalization of gambling/casinos? Support your claim.

Did your opinion change? Why or Why Not? (Please note the piece of evidence that either solidified your thinking or changed it)

Expand your opinion into a 1-2 page position paper on the issue of casino gambling. Support your position with multiple pieces of evidence.

Paragraph One – Issue and Position

Utilize this paragraph to clearly outline the main problems associated with the topic. The point of the paragraph is to provide a basic foundation as to the current situation associated with your topic. This section of your position paper should not exceed five to six sentences.

Paragraph Two – Detailed Background Information

This paragraph is an opportunity for you to show the depth of your knowledge about the past and current situations regarding the topic. Be sure to discuss:

Historical origin of the problem, particularly why the problem arose

Previous actions related to the topic

Successes and failures of past actions and why they succeeded or failed

Problems that continue to exist or ones that have not yet been addressed

Devoting two to three sentences per item on this list should allow you to have sufficiently discussed the topic and to set the foundations for the final paragraph of your position paper.

Paragraph Three –Your Opinion on the Issue

This paragraph is the one that will set your paper apart from the others. After identifying the issues in paragraph two, utilize this paragraph to list your thoughts on the issues enumerated above. The quality of your argument could be a great determinant in the overall evaluation of your position paper. Some items to consider

Specific proposals regarding the issue

How it could be implemented, including the feasibility

impact of building a casino or not

Characteristics of a Free Market Economy

Episode Used: “Husbands and Knives”

Watch in class from the beginning of the episode at The Android’s Dungeon up until the point where Marge’s gym opens in the space that formerly housed The Android’s Dungeon.

Activity: Have the students read independently the features of a system of free enterprise provided below. Once the students are done, briefly discuss the concepts to make sure they understand each one before starting the episode. After the conclusion of the clip, have the students discuss in small groups what they found as examples of a free enterprise system at work. Possibly reconvene as the entire class to discuss more in-depth.

Features of American Free Enterprise

Free enterprise in America is founded on ideas so basic to our culture that we tend to take them for granted. As you watch the clip from The Simpsons, write down an example of each characteristic as seen in the episode. For homework, explain on the back of your paper what the government does to protect each feature.

Economic Freedom: In the United States, individuals have the right to choose their occupations and to work wherever they can find jobs. Businesses can make their own decisions on whom to hire, what to produce, how much to produce and how much to charge for their products and services. The government generally does not interfere in these decisions.

Competition: Producers have the right to engage in rivalries to gain business. Competing producers have an incentive to create new and better products. This gives consumers more economic choices.

Private Property: Individuals and businesses have the right to buy and sell as much property as they want. Property owners may prohibit others from using their property.

Contracts: Individuals and businesses have the right to make agreements to buy and sell goods. Such contracts may be written or oral. They are legally binding.

Voluntary Exchange: Consumers and producers may freely buy and sell goods when the opportunity costs of such exchanges are worthwhile. In a voluntary exchange, both parties expect to gain from the transaction.

Self-Interest: Consumers and producers may make decisions on the basis of their own benefit. Their decisions do not have to benefit or please the government or other consumers and producers.

Profit Motive: American free enterprise is driven by the desire for profit, the gain that occurs during financial dealings. Profit is a powerful incentive that leads entrepreneurs and businesses to accept the risk of business failure.

CONCLUDING THOUGHTS

In this brief pedagogical note we provide detail on some assignments designed to teach economics to high schoolers through the television show The Simpsons. It is important to note that these assignments should be used in addition to traditional instruction. To teach economics well at the secondary level, teachers have to focus on a few core concepts and give the students many opportunities to hear, discuss, and use the ideas in order for them to stick. In the words of the famous social scientist Herbert Spencer (1978), "…only by varied iteration can alien conceptions be forced on reluctant minds."

In our experience, when students sometimes struggle with a particular abstract concept, fictional examples give a concreteness that help students sort through the issues. For example, students often struggle with questions related to price in a market versus prices set by businesses. They don't, in the abstract, understand all of the decisions and factors that influence a price for a product and how a seller would know they are making a profit. After watching The Simpsons episode "Bart Gets an Elephant," however, students seem to have a much better understanding of prices and the price mechanism. If a seller is selling their product at a price that is too low, they will be running their business at a loss like Homer. If they suddenly change their prices to reflect their costs, they risk losing their business as Homer. This highlights for them how even items that can be sold for a high price can lose money if the costs of providing that good or service are high enough.

REFERENCES

Barkley, Elizabeth F (2009) Student Engagement Techniques: A Handbook for College Faculty. New York: Jossey-Bass.

Becker, William E(1997) "Teaching Economics to Undergraduates." Journal of Economic Literature 35 (3):1347-1373.

Becker, William E and Michael Watts(1995)"Teaching Tools: Teaching Methods in Undergraduate Economics." Economic Inquiry 33(4):692-700.

———(1996) "Chalk and Talk: A National Survey on Teaching Undergraduate Economics." American Economic Review 86 (2):448-453.

——— (2001) "Teaching Economics at the Start of the 21st Century: Still Chalk-and-Talk." American Economic Review 91 (2):446-451.

Becker, William, William Greene, and Sherwin Rosen. "Research on high school economic education." Journal of Economic Education 21(3):231-245.

Booth, William (1992) "Mississippi Town Bets Its Future on New Riverboat Gambling Casinos." Los Angeles Times, 30 August.

Brown, Peter C and Mark A McDaniel(2014) Make It Stick: The Science of Successful Learning. Cambridge: Belknap Press.

Chu, Shiou-Yen (2014)"An Assessment of Teaching Economics with The Simpsons." International Journal of Pluralism and Economics Education 5 (2):180-196.

Davis, Mary E (2015) "Bringing Imagination back to the Classroom: A Model for Creative Arts in Economics." International Review of Economics Education 19:1-12.

Diamond, Arthur M(2009) "Using Video Clips to Teach Creative Destruction." The Journal of Private Enterprise 25 (1):151-161.

Dixit, Avinash (2005) "Restoring Fun to Game Theory." Journal of Economic Education 36 (3):205-219.

———(2012) "An Option Value Problem from Seinfeld." Economic Inquiry 50(2):563-565.

Ferrarini, Tawni H (2012) "Economics in the Media: Cool Tools for Teaching Economics." Social Studies Research and Practice 7(1):19-28.

Geerling, Wayne (2012) "Bringing the 'Dismal Science' to Life: Teaching Economics Through Multimedia." International Review of Economic Education 11(2):81-90.

Ghent, Linda S, Alan Grant and George Lesica (2011)"The Economics of Seinfeld." The Journal of Economic Education 42 (3):317-318.

Gillis, Mark T and Joshua C Hall (2010)"Using The Simpsons to Improve Economic Instruction through Policy Analysis." American Economist 55(1):84.

Gottschall, Jonathan(2012) The Storytelling Animal: How Stories Make Us Human. New York: Houghton Mifflin Harcourt.

Hall, Joshua C (2005) "Homer Economicus: Using The Simpsons to Teach Economics." Journal of Private Enterprise 20(2):165-176.

——— (2012) "Incorporating EconTalk Podcasts into the Principles Classroom." Journal of Private Enterprise 28 (1): 113-118.

——— ed (2014) Homer Economicus: The Simpsons and Economics. Stanford: Stanford University Press.

Hall, Joshua C., and Marta Podemska-Mikluch (2015) "Teaching the Economic Way of Thinking through Op-Eds." International Review of Economics Education 19:13-21.

Heath, Chip and Dan Heath (2007) Made to Stick: Why Some Ideas Survive and Others Die. New York: Random House Audio.

Holian, Matthew J(2011)"Using Drew Carey in the Classroom." Journal of Private Enterprise 26(2):161-167.

Lawson, Robert A (2006) "Teaching Economic Principles with Comic Strips." Journal of Private Enterprise 22(1): 168.

Lawson, Robert A, Joshua C Hall and G Dirk Mateer (2008) "From Abba to Zeppelin, Led: Using Music to Teach Economics." Journal of Economic Education 39(1):107.

Leet, Don and Scott Houser(2003)"Economics Goes to Hollywood: Using Classic Films and Documentaries to Create an Undergraduate Economics Course." Journal of Economic Education 34(4):326-332.

Luccasen, R Andrew and M Kathleen Thomas (2010) "Simpsonomics: Teaching Economics Using Episodes of The Simpsons." Journal of Economic Education 41(2):136-149.

Luther, William J(2015) "Using NPR's Planet Money Podcast in Principles of Macroeconomics." Journal of Private Enterprise 30 (1):143-154.

Mateer, G Dirk(2004) Economics in the Movies. Mason: South-Western College Pub.
Mateer, G Dirk, Linda S Ghent, and Misty Stone (2011)"TV for Economics." The Journal of Economic Education 42(2):207-207.
Mateer, GDirk and E Frank Stephenson (2011) "Using Film Clips to Teach Public Choice Economics." Journal of Economics and Finance Education 10:28-36.
Podemska-Mikluch, Marta and Darwyyn Deyo (2014) "It's Just Like Magic: The Economics of Harry Potter." Journal of Economics and Finance Education 13(2):90-98.
Podemska-Mikluch, MartaDarwyyn Deyo and David T Mitchell(2015) "Public Choice Lessons from the Wizarding World of Harry Potter." The Journal of Private Enterprise 31(1):57-69.
Salemi, Michael K (2002) "An Illustrated Case for Active Learning." Southern Economic Journal 68 (3):721-731.
Schug, Mark C and William C Wood, eds (2011)Teaching Economics in Troubled Times: Theory and Practice for Secondary Social Studies. New York: Routledge.
Schug Mark C, Mary C Suiter and William C Wood (2015)"From the Cross of Gold to Central Banking: Three Key Episodes in American Financial History." Social Education 79 (2):82-88.
Swift Jim (2014) "The Great Casino Loophole: Why Indian Gaming is Proliferating." Weekly Standard, November.
Spencer, Herbert (1978) The Principles of Ethics. Indianapolis: Liberty Fund.
Van Horn, Robert and Monica Van Horn(2013)."What Would Adam Smith Have on His iPod? Uses of Music in Teaching the History of Economic Thought." Journal of Economic Education 44 (1):64-73.
Watts Michael and William E Becker (2008) "A Little More than Chalk and Talk: Results from a Third National Survey of Teaching Methods in Undergraduate Economics Courses." Journal of Economic Education 39 (3):273-286.
Walstad, William B and John C Soper (1988) "A Report Card on the Economic Literacy of US High School Students." American Economic Review 78 (2):251-256.

TILTING A COURSE INSTEAD OF FLIPPING IT: AN EXPERIMENT IN PARTIALLY FLIPPING A PRINCIPLES OF MICROECONOMICS COURSE

Stephen M. Kosovich, Stephen F. Austin State University

ABSTRAT

Flipping a class has recently become a common method of increasing active learning time in a variety of disciplines. This study explains how a partially flipped Principles of Microeconomics course was created using short video lectures, how students reacted to the introduction of these videos, and compares student performance on exams to non-flipped sections. Although there is only evidence that suggests student performance improved on one of the four exams as compared to non-flipped sections, this study provides a low-cost framework for any instructor interested in experimenting with flipping the classroom.

Keywords: *flipped classroom, Principles of Economics, video lectures*

INTRODUCTION

Traditional instructional models in introductory economics courses generally rely on in- class lectures and homework or assigned problems to be completed by students outside of class. Although some instructors have long incorporated various flipped teaching techniques, with readings or videos assigned outside of class and in-class time focused on small group discussions and problems solving, there has been a recent burst of attention regarding the flipped/inverted classroom model (Bishop & Verleger, 2013; Herreid & Schiller, 2013; Lage et al., 2000). This renewed interest largely involves the use of videos to replace traditional in-class lectures, as well as the use of other technology to facilitate both in-class and outside of class interactions between students as well as the instructor.

This study explains an experiment in a partial flipping of two sections of Principles of Microeconomics during the Spring 2016 term. These classes will be referred to as partially flipped or 'tilted' because they were specifically designed not to be completely flipped. One of the major disadvantages of the fully flipped class is the significant upfront cost in time and effort of transitioning a class from a more traditional format (Hall & DuFrene, 2015). A partial flip provides an opportunity for instructors to try out the technique without such a large up-front investment in time, and can allow for an instructor to try out the technique's effectiveness. After reviewing the literature on flipped classes, I provide my experience in tilting the classroom, discuss how students respond to videos with low stakes quizzes, compare performance of students in these tilted sections to two traditional sections from the prior term of instruction, and provide some lessons learned during the experience.

LITERATURE REVIEW

There are now many examples of instructors using video lectures in undergraduate courses. Figlio et al., (2013) randomly assigned students to either sections with a typical large in-class lecture or to a section with access to videos of these same lectures but no classroom meetings. The authors found modestly higher test scores for students assigned to in-class lectures, with larger positive benefits to lower GPA and male students. Olitsky and Cosgrove (2016) compared student learnings gains in a traditional Principles of Microeconomics course to a combination flipped/blended section. The flipped/blended section combined flipping, which involved video lectures watched outside of class and small group activities inside of class, with online blending. Although the online blending reduced the number of in-class contact hours as compared to a traditional section, students in the flipped/blended class showed larger increases in performance on exams than students in the traditional lecture sections.

Both of these studies were designed to examine whether videos could provide a way to lower the cost of course delivery. In contrast to Figlio et al., Olitsky and Cosgrove also designed the flipped/blended sections to incorporate the main perceived advantage of flipping, which is that students use time outside of class to learn the basic terminology and focus on more difficult concepts and developing higher order thinking skills with their peers inside of class. A true flipped classroom does not reduce the time spent in class; it simply shifts the focus of classroom time to problem solving, small group activities, and other non-lecture activities.

Perhaps because of the importance of time spent solving problems, the flipped approach has become increasingly popular in some of the more quantitative disciplines and several studies have provided evidence that flipping increased student performance in these areas (Crouch & Mazur, 2001; Deslauriers et al., 2011; Freeman et al., 2014; Formica et al., 2010). Talbert (2012) noted that it was several economists who appear to have coined the term ‘inverted classroom’, although Roach (2014) noted that comparatively little research has been conducted on flipping economics courses. In Roach’s study of student perceptions of a partially flipped Principles of Microeconomics class, he noted that students generally responded positively to the flipping, and reported that 94% of students believed the class was more interactive than their other courses.

Calimeris and Sauer (2015) randomly assigned one of two Principles of Microeconomics sections to be flipped, while the other section remained in the traditional lecture format. The flipped sections’ students were assigned to watch 1-4 videos before each class, with small, low stakes quizzes on the content material. Videos varied in length between 4-21 minutes, and freed up class time to be spent on experiments, discussions of news articles, and working on problems independently and in groups. The authors find significantly higher performance on the second midterm and the final exam for students in the flipped section, as compared to the traditional classroom setting.

Although Calimeris and Sauer reported generally enjoying the experience of teachings a flipped classroom, they were also careful to note the high upfront costs of developing the content. Because the class was a complete flip, all of the in-class lecture material was moved outside of class, which meant that the videos were necessarily rather lengthy. Indeed, the authors reported the most common student complaint of the flipped class was that the

videos were too long. Videos were produced as a voice over PowerPoint slides with screencast software.

One unanswered question in the flipping literature is whether the reported gains from flipping can be found in a partial flip of the course. If the gains from student learning occur because of collaborative in-class exercises, do these gains increase linearly with respect to the amount of active learning activities? Or is there some threshold of flipping that must be met in order to see improvements in student learning? Several other important questions remain including:

> *Will students watch videos of lectures? How should students be motivated to watch? What information should the videos contain and how long should they run?*
> *What technology should be used to make the videos? Should one use screen capture technology or a camera that captures the instructor in the frame?*
> *What types of exercises should be done in-class to replace the lecture time? Will the flip increase instructor and/or student satisfaction?*

RESEARCH DESIGN

In order to compare student learning in traditional lecture sections to those in tilted sections, student performance on exams was recorded for two sections of Principles of Microeconomics courses in the Fall 2015 term to provide a control group. Exams were not returned to students during this particular term, in order to compare student performance on these exact questions during the subsequent term. For the preceding 10 years, I have consistently handed back exams and created new exams the next term. However, given this experiment, I retained the exams during the Fall 2015 term so that the exact questions could be compared to the partially flipped sections in Spring 2016. Given the consistent history of creating new exams each term, it is unlikely that students were aware that exam questions would be identical across these two terms.

Each Fall term section enrolled approximately 60 students each, and these sections were taught primarily using lectures, although approximately 15 percent of class time was used for collaborative work on problems and/or assignments. Students received participation credit for completing these in-class assignments, and they were also expected to complete additional online homework assignments using the Aplia online homework system. The experimental group was two partially flipped sections of Principles of Microeconomics in Spring 2016, with 70 students enrolled per section. Instead of in-class participation points, students took low stakes quizzes over the content in the assigned videos. Any in-class exercises and problems were completed for no course grade, and the weights of Aplia homework and exams were identical to the previous term's courses. I taught all four sections of the course and made no other major changes to content coverage, lecture notes, or other pedagogical materials or techniques.

During the winter break, I recorded 11 videos between approximately 7 and 15 minutes in length, using a high definition camcorder. Videos were meant to simulate my in-class lecture style and a fixed camera was positioned to include the instructor in-frame along with a blackboard. The purpose of each video was to simply introduce terminology and to motivate the key ideas for each topic, rather than to be a detailed and comprehensive

explanation of the entire topic. For example, a video on elasticity provided a motivation as to why someone would care about the topic, some definitions, a formula for the price elasticity of demand and a comparison of several price elasticities for different goods. The more involved portions of the topic, such as the link between elasticity and total revenue and the actual application of the midpoint method were reserved for in-class lecture. Because the material was rather introductory, the decision was made to use a traditional lecture setup rather than a screen capture, and students were prompted to take notes synchronously as they did for in-class lectures.

A partial flip of this nature has been suggested as a best practice for several reasons (Hall& DuFrene, 2015). First, the upfront cost to the instructor is relatively low. The videos were also designed to replicate a lecture, in order to minimize development time. No special software was required and no additional narrated PowerPoint slides need to be created; the videos relied on already existing lecture notes to introduce the topic. Because the videos mimicked a lecture, I did not feel the need to heavily edit the videos and small imperfections were left as is. Videos were uploaded to YouTube and shared privately to students in the two Spring 2016 Principles of Microeconomics sections via links in the university's course management system.

In order to provide an incentive to watch the videos, eight short quizzes consisting of five multiple choice questions each were created and placed in the course management system, with a deadline set 15 minutes before each class meeting. The remaining three videos were not linked to any quiz for two reasons. First, it allowed for the overall weight of the exams and Aplia assignments to be identical to the Fall 2015 sections. Second, it provided evidence as to whether the quizzes were necessary to motivate student viewing.

The main reason for the flip was to provide for more in-class problem solving time. Additional materials were created during the Spring 2016 term as needed. This added flexibility allowed for just-in-time responses to student learning needs. On days when the video was due,class started with a very brief outline of the video written on the board, and I answered any questions the students had about the material in the video. Again, the prior term's sections already included some problem solving time and opportunities for student questions built into the course. The tilt ensured that students were aware of the basics of the material before arriving to class for the particular lecture, and increased the time that could be spent collaboratively solving problems. Much of the additional time was spent on additional problem worksheets and other small group work. In prior terms this time often was rushed and some students were unable to complete the entire set of problems. The partial flip allowed for more leisurely and relaxed in- class activities.

RESULTS

YouTube provides a variety of analytical data to uploaders of videos. Table 1 contains the broad topic area for each of the 11 videos, the total number of views for each, length of videos, average view duration and percent of video watched, and whether the video was associated with a quiz. It also identifies the timing of exams in the course. At the beginning of the Spring 2016 term, exactly 140 students were enrolled in the partially flipped sections of Principles of Microeconomics, although there was some attrition over the course of the term. Again, the videos were shared in the course management system as private links in

YouTube, so it is highly unlikely that a video was viewed by anyone not enrolled in the course.

As the number of views suggests, students largely watched the videos. In fact, some students clearly watched the videos multiple times during the course. Although not reported in this study, YouTube also provides the video uploader information about the time and date each video is watched. The vast majority of views occurred the day before or the morning of the quiz due date. A smaller number of views occurred immediately before the regular exams and the comprehensive final exam. Some students appear to have used the videos when reviewing for exams.

It is also clear that the low stakes quizzes helped to motivate student viewing. There were fewer total views for videos 1, 5, and 11, which were not linked to any quiz. These videos also had lower average durations of viewing. Although quizzes were worth less than one percent of the course grades each, the results suggest that incentives to watch need not be large. Average quiz grades were approximately 84 percent, which reflects the fact that the quizzes were not written to be particularly challenging for those students who watched carefully. Again, the material in the videos was only designed to introduce students to the basics of a topic area.

Table 1
VIDEO DETAILS

Video number	Topic area of video	Total views	Video length	Average view duration	Average percent duration	Online quiz?
1	Math review	75	11:11	5:51	52%	no
2	PPF	220	6:55	5:21	77%	yes
3	Supply and demand	192	13:44	9:54	72%	yes
4	Elasticity	187	13:19	10:42	80%	yes
	Exam #1					
5	Efficiency of markets	125	16:48	10:25	62%	no
6	Price controls	205	12:07	8:47	73%	yes
7	Taxes	190	13:18	10:02	76%	yes
	Exam #2					
8	Firm theory	173	14:27	10:16	71%	yes
9	Perfect competition	161	9:54	9:03	92%	yes
10	Monopoly	147	15:08	11:43	77%	yes
	Exam #3					
11	Oligopoly	59	11:31	6:16	54%	no
	Final exam					

Perhaps the most important question is whether student learning increased under the partial flip. Again, a common set of questions was maintained across the two terms of instruction. Specifically, there were 35 common questions on each of the first three exams and 50 common questions on the comprehensive final examination. Table 2 reports the number of correct answers on the three regular exams and the comprehensive final exam. A two-

tailed t- test was conducted for the two samples and the results are reported in Table 2. The mean exam score is only statistically different (at the 1 percent level) for exam #1, in which students on average answered more questions correctly in the tilted class sections. Although mean performance on exams #2 and #3 was slightly higher in the partially flipped sections, there is no evidence to conclude that a significant difference exists.

Table 2
COMPARISON OF EXAM PERFORMANCE

	Fall 2015: Traditional	Spring 2016: Tilted		
	Mean correct answers (number of students in parentheses)		T-statistic	P-value
Exam #1	23.7	26.0	3.600	0.0004
N=	(120)	(138)		
Exam #2	25.2	25.4	0.475	0.3175
N=	(120)	(134)		
Exam #3	23.3	23.9	0.967	0.1672
N=	(118)	(133)		
Final Exam	35.0	35.0	-0.010	0.4961
N=	(116)	(133)		

DISCUSSION

Several questions were answered by this study. First, students will watch videos outside of class, particularly if there is a quiz associated with the videos. The percent of the overall grade attached to these quizzes need not be large to induce viewing. Although students in the partially flipped class performed better on the first exam, on average, there was no evidence of improvement for the remaining exams in the course. There are several explanations for this lack of improvement. First, the amount of the course that was flipped was relatively small, by design. Less than 120 minutes of total video lecture was recorded. Second, the course already contained some interactive problem solving prior to the flip. As noted, approximately 15 percent of class time was already spent on problems and other interactive activities in prior terms of instruction. The videos did allow for several additional hours of in-class problem solving time over the course of the term, but the overall change in course structure was modest.

It is also possible that student attentiveness with respect to the videos decreased as the term progressed. Video quizzes were meant to be relatively straightforward and students may have learned they could casually watch videos without paying full attention to the concepts. Although the data show that students continued to watch videos with related quizzes, there is no way to determine the intensity with which they watched. If they lacked the necessary basic understanding of terminology before coming to class, the in-class exercises and group work would have become less effective as the term progressed. Also, no course credit was linked to these in-class exercises. Linking the activities to the course grade might have helped to encourage more sustained and serious in-class effort. Finally,

because of the extra classroom time, additional problems and activities for students needed to be created during the term. Unlike existing activities, these worksheets, problems, and activities were brand new, and more uneven in quality. In future terms, there will be additional opportunities to develop a larger set of activities to help scaffold students' understanding of the topics.

As noted, Calimeris and Sauer reported enjoying the fully flipped classroom experience. I also found the experience to be rewarding for several reasons. First, lectures became a little bit less about definitions and more focused on examples, more complex issues, and the synthesis of ideas. Class time also seemed less rushed and more relaxed. Although the sections were relatively large, the additional collaborative learning time also allowed for more interaction with students. I had more time to wander the room while the students were working together, to see where more time needed to be spent and whether the majority of students understood a particular concept. Student feedback via end of the semester course evaluations was also very positive. There were no negative comments about the videos, and it is unclear whether students even understood that any changes had been made to the course. The most common positive feedback was about what they referred to as 'the worksheets' and what they perceived to be the large amount of in-class problem solving.

CONCLUSION

Although the flipped classroom concept is not new, it has recently become a more widespread technique to increase active learning time inside the classroom. One of the major obstacles impeding instructors from moving to this teaching model is the large cost of developing both video lectures and the active learning activities that replace lecture time. As this study demonstrates, one need not commit to a full flipping of course material in order to increase time spent on collaborative problem solving. Additionally, no technology beyond a good camera and a blackboard are required to begin flipping a class. Because the videos can simply mimic a standard lecture, it is also possible for an instructor to partially flip a course without learning any new software packages. The entire upfront cost was several hours of video recording time, and a small amount of additional time spent during the term creating online quizzes and in-class activities. In the future, additional videos can be added to the existing inventory. In this study, student performance on exams did not suggest learning gains over the traditional classes, except for the first exam. However, over time as the in-class activities become more refined and additional videos are added, performance may improve.

REFERENCES

Bishop JL & Verleger MA (2013) The flipped classroom: A survey of the research.In *ASEE National Conference Proceedings, Atlanta, GA*.

Calimeris L & Sauer KM (2015) Flipping out about the flip: All hype or is there hope? *International Review of Economics Education*, *20*,13-28.

Crouch CH & Mazur E (2001) Peer instruction: Ten years of experience and results. *American Journal of Physics*, *69*(9),970-977.

Deslauriers L, Schelew E & Wieman C(2011)Improved learning in a large-enrollment physics class. *Science*, *332*(6031), 862-864.

Figlio D, Rush M & Yin L (2013) Is It Live or Is It Internet? Experimental estimates of the effects of online

instruction on student learning. *Journal of Labor Economics*, *31*(4),763-784.

Formica SP, Easley JL & Spraker MC (2010)Transforming common-sense beliefs into Newtonian thinking through just-in-time teaching. *Physical Review Special Topics-Physics Education Research*, *6*(2),1-7.

Freeman S, Eddy SL, McDonough M,Smith MK,Okoroafor N, Jordt H & Wenderoth MP (2014)Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415.

Hall AA & DuFrene DD (2015) Best practices for launching a flipped classroom. *Business and Professional Communication Quarterly*, Advance online publication. doi: 10.1177/2329490615606733

Herreid CF & Schiller NA (2013) Case studies and the flipped classroom. *Journal of College Science Teaching*, *42*(5),62-66.

Lage MJ, Platt GJ & Treglia M (2000) Inverting the Classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, *31*(1),30-43.

Olitsky NH & Cosgrove SB (2016) The better blend? Flipping the Principles of Microeconomics classroom. *International Review of Economics Education*, *21*,1-11.

Roach T (2014) Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics. *International Review of Economics Education*, *17*,74-84.

Talbert R (2012) Inverted classroom. *Colleagues*, 9(1),18-19.

REAL EXCHANGE RATES AND THE MACROECONOMY: THE CASE OF NIGERIA

Oluremi Ogun, University of Ibadan

ABSTRACT

This paper addressed the issue of the relative strength of different measures of the real exchange rate at influencing economic growth and selected indicators of development on the economic scene. The real exchange rate was noted to be about the most important relative price in the economy as it influenced nearly all other relative prices. Understanding its potency as a measure of economic performance/signal of developments on the economic scene necessitates an examination of the relative predictive power of its definitions. In this study therefore, an unweighted multilateral index and three geometrically weighted measures of the real exchange rate were tested for causality relations with the gross domestic product and the indicators. The causality tests were of the Granger type. An open developing economy's data were employed in the analysis that covered the period, 1962-2011. The data series were shown to be generally normally distributed. The results suggested that at level, the differences in the definitions of real exchange rate were inconsequential as the relevant indices generally returned similar performance. Regardless of the form of the data series, level or order of integration, non-oil export was the variable consistently explained by real exchange rates under the full sample. A somewhat similar general performance was recorded with a subsample isolating the period of oil export booms in the country when both interest rate and foreign direct investment were documented as Granger-causing the real exchange rates. The export weighted real exchange rate posted superior performance during the booming period but the unweighted real exchange rate recorded the generally most outstanding performance under the full sample. All these results were invariant to the form of the data series, whether at level or order of integration. While the overall results suggested the possibility of the appropriate measure of real exchange rate being distinct to an economy, a widespread test of other countries' data was recommended for a supported generalized conclusion.

Keywords: *Econometrics, quantitative policy modeling, foreign exchange, open economy macroeconomics.*

JEL Codes: C01; C54; F31; F41.

INTRODUCTION

The prime question asked in this study is, does the choice of weight in real exchange rate (RER) computations significantly matters for signaling economic performance and developments on the economic scene? RER is about the most important relative price in the economy as it influences nearly all other relative prices. As a result, it exerts critical influence on resource allocation, trade pattern and volume, and, structural change at least, in the short run. An examination therefore of the relative importance of its definitions is crucial to understanding its potency as a measure of economic performance/signal of developments in the economy. This is

the essence of this paper. In evaluating the relative performance of the choice of weight, cognizance was taken of relevant economic justifications juxtaposed with a statistical exercise that simply assumed nil/negligible difference in the effects of choice of weight. An open developing economy's data were used for the investigation.

The paper is organized as follows. Following this introduction is a brief review of the framework of measurement and the analytical method. This is succeeded by a discussion of the structure and characteristics of RER measures. In section 4, a comparison of the effects of the different RER measures on defined indices of economic performance/developments on the economic scene is undertaken. Section 5 made some concluding observations.

FRAMEWORK OF MEASUREMENT AND METHODOLOGY

The RER is the relative price of tradables and nontradables. It was originally conceived in terms of the Purchasing Power Parity (PPP) doctrine that could either be absolute or relative. The economically more relevant relative PPP viewed the equilibrium RER as a constant that was impervious to changes in key economic variables. The necessity to reflect changes in fundamentals on RER equilibrium led in part to redefining the concept in terms of the relative price of two goods as stated in the beginning of this section. This definition is otherwise referred as the Salter-Swan framework (see Salter 1959; Swan 1956).

Under the modern view, the measurement biases inherent in the prices used in computation are eliminated by choosing a price index consisting more of tradable goods to represent the foreign price while one consisting more of nontradable goods is used to proxy domestic price. Thus, the basic or unweighted RER is usually computed as the product of the nominal exchange rate index and the ratio of the wholesale price index (or equivalent e.g. finished goods' price index) of the foreign country and the consumer price index of the home country. In equation, it appears thus:

(1) $RER = NER * \left[\frac{P_T^f}{P_N^d}\right]$

Where, RER is unweighted real exchange rate, P_T^f is foreign price of tradables and P_N^d is domestic price of nontradables.

In weighting the RER, some basic steps have to be followed. First, the relevant countries to be taken into consideration would need to be ascertained; the countries should account for a highly significant proportion of the domestic country's trade. Second, data on trade shares (exports and imports in relation to the total of the country implied by the flows to and from the admissible countries as well as relative to world totals) would be necessary. The RER could be import, export or total trade weighted, the determining factors of the choice of weight being the exchange rate policy of the domestic or home country, the developments in the country's foreign trade sector, the country's share of world trade and its commercial policy. With the modern view of the RER, countries in international trade are assumed to be small relative to world total and if in the present context, the influence of commercial policies such as tariffs and subsidies were assumed to be somewhat reflected in domestic prices, we need only to bother about the first two factors. Thus, a weighted RER, now the real effective exchange rate (REER), could appear as:

(2) $REER = NEER * \left[\sum_{i=1}^{n} \frac{wiPi}{P^d}\right]$

Where, NEER is nominal effective exchange rate, that is, NER that is trade weighted; *wi* is trade weight assigned to the ith trade partner, - in the context of total trade for example, it is measured as $(Xi + Mi)/(X_p + M_p)$ with $Xi + Mi$ representing exports and imports of the ith country and

$X_p + M_p$ are total exports and imports to and from trade partners; Pi is the price index of the ith trade partner; P^d is the price index of the domestic economy.

The weighting method described above is an arithmetic process. There is a geometric weighting option under which multiplication takes the place of addition in aggregating the trade shares and imports' and exports' totals; an exponential process (in which the power is represented by the weight) is applied to the products of the components of the nominal exchange rate and price ratios. The REER under this approach is computed as:

(3) $REER = NEER * \prod_{i=1}^{n} \left(\frac{Pi}{Pd}\right)^{wi}$ [or] $\prod_{i=1}^{n} \left(NER\frac{Pi}{Pd}\right)^{wi}$

Where, $\prod_{i=1}^{n}(.)$ indicates the product of the elements in the bracket.

Movements in REER under the arithmetic weighting are highly susceptible to the unit of expression of exchange rate i.e. currency or pence/cent rate. Distortions in exchange rate indexes under this weighting option could also result when base year is changed and under this approach, the weights change overtime even when they had been fixed initially (Koch 1984; Rosensweig 1987). The geometric weighting alternative does not suffer these disabilities because it views exchange rate movements as symmetrical (Rosensweig 1987). Although, it could complicate the computation of average rates for particular periods, it is generally preferred to the arithmetically weighted option and indeed, it is deemed the most appropriate for the purpose.

The basic analytical method in this paper hinges on the causality approach of which the most popular version in recent time has been the Granger causality. Basically, this approach seeks to explain the extent to which the current value of a variable say Y, can be explained by its past values as well as the possible assist from the past values of an exogenous variable say X, in the prediction process. Thus, Y is said to be Granger-caused by X if X helps to predict Y or the coefficients on the lagged Xs are statistically significant (Granger 1969). Therefore, we write that:

(4) $Y_t = Y(Y_{t-i,}\, X_{t-i})$

Where, Y_t is the current or predicted value of variable Y, $Y_{t-i,}$ are its lagged values and X_{t-i} are the lagged values of the exogenous variable X. For annual data series, lags could be up to 4.

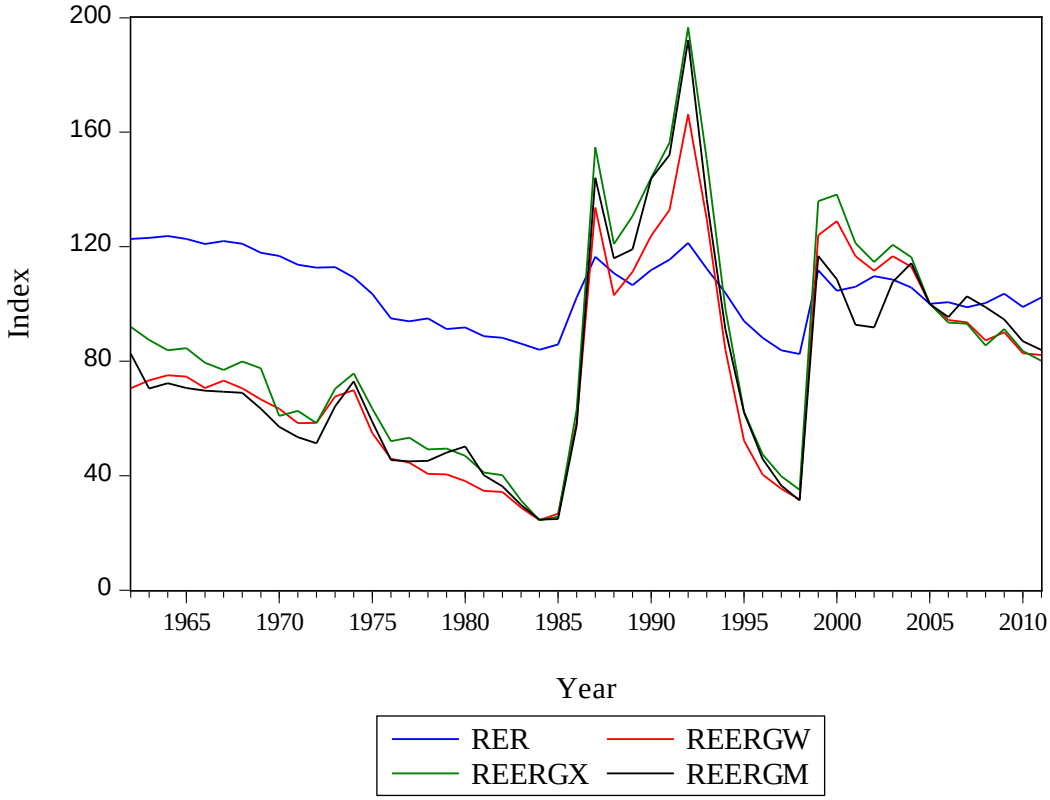
Causality analysis is usually conducted on the level of variables. However, as the prime essence of the analytical approach is the elimination of the possibility of spurious correlation, there would appear to be some sense in allowing for the order of integration of the data series in causality analysis. Results of this experiment are provided in this paper.

STRUCTURE AND CHARACTERISTICS OF REAL EFFECTIVE EXCHANGE RATES: NIGERIA

Four measures of the RER were computed viz: unweighted RER (RER), trade weighted RER (REERGW), export weighted RER (REERGX) and import weighted RER (REERGM), the last three being geometrically weighted series. The weights were the exports and imports of Nigeria vis-à-vis her major trade partners which were United States, United Kingdom, Germany, Italy, France, the Netherlands, Japan and Switzerland. These partners accounted successively for about 79%, 55% and 67% of Nigeria's exports, imports and total trade in the period 1962 to 2011. All the data used in the computation were at 2005 prices. (All the data used in this study and their sources could be obtained from the author upon request).

The trends of the different measures are shown below in figure 1. Generally, the measures appeared to have moved together but the trend of the import weighted measure was noticed to be steeper.

Fig 1: Real Exchange Rates - Nigeria



Source: Computed

A summary of the statistics on the different measures is presented in Table 1.

Table 1

DESCRIPTIVE STATISTICS - REAL EXCHANGE RATES: NIGERIA

	RER	REERGW	REERGX	REERGM
Mean	104.8460	76.9800	84.7874	78.7368
Median	105.1500	71.9233	79.9854	70.5307
Maximum	123.7000	166.2552	196.6161	192.1756
Minimum	82.5000	24.5055	24.4042	24.6903
Std. Dev.	12.1824	34.5210	38.8223	36.6452
Skewness	-0.1660	0.4182	0.6620	0.7909
Kurtosis	1.9534	2.3810	2.9918	3.4317
Jarque-Bera	2.5114	2.2557	3.6532	5.6020
(Probability)	0.2848	0.3237	0.1609	0.0607
Sum	5242.30	3849.00	4239.37	3936.84
Sum Sq. Dev.	7272.24	58393.39	73851.71	65800.97
Observations	50	50	50	50

Source: Computed

The unweighted RER had the highest mean, median and minimum values; it however recorded the lowest maximum value and least deviation from mean. Also, it was skewed more to

the left of its mean value and was characterized by the least level of peakedness. Except for the import weighted series, all the measures appeared to be normally distributed.

In Table 2, an idea of the extent to which the different measures co-moved is shown. As should be expected, the weighted measures exhibited significantly higher correlations among themselves than with the unweighted RER.

Table 2

CORRELATIONS

	RER	REERGW	REERGX	REERGM
REERRV	1.00	0.57	0.59	0.53
REERGW	0.57	1.00	0.98	0.96
REERGX	0.59	0.98	1.00	0.97
REERGM	0.53	0.96	0.97	1.00

Source: Computed

THE CAUSALITY ANALYSES

Six indices of policy/economic performance were chosen for assessing the predictive power of the different measures of RER. They were foreign direct investment (FDI), real gross domestic product (RGDP), real interest rate (RIR), non-oil exports (NEXP), external debt (ETDT) and domestic inflation (INF). (The relationship between RER and these indicators had been well advertised, see e.g. Frenkel and Goldstein, 1988; Pinto, 1987; Harberger, 1986; Edwards and Aoki, 1983; Edwards, 1989, and, Rodrik, 2008; in terms of theoretical insights or essential contributions on the economic significance of RER, the literature appeared to have leveled off around the late 1980s). Four sets of causality results were presented; the first two involved the full sample of 1962 to 2011 at level and the corresponding order of integration while the other two related to a subsample, 1973 - ‘80 and 1999 - 2007 with the tests differentiated as under the full sample. The idea behind the subsample was to ascertain whether there could be significant differences in the causality results of a booming economy (oil export boom) and a going-concern economy (that is, the full sample). All variables were in log.

Table 3

The Causality Results - Level

Sample: 1962-2011

Lags: 4

Null Hypothesis	Obs.	F Statistics			
		RER	REERGW	REERGX	REERGM
RIR, RER	46	2.8390(0.03)	2.8463(0.03)	2.1909(0.08)	2.0732(0.10)
RER, RIR	46	1.6606(0.17)	1.9623(0.12)	2.2205(0.08)	1.8419(0.14)
RGDP, RER	46	0.6409(0.63)	1.1552(0.34)	1.3390(0.27)	1.4415(0.23)
RER, RGDP	46	1.3472(0.27)	1.5772(0.20)	1.4739(0.22)	1.3872(0.25)
FDI, RER	46	0.5481(0.70)	0.0501(0.99)	0.1450(0.96)	0.0695(0.99)
RER, FDI	46	0.8813(0.48)	0.0420(0.99)	0.0481(0.99)	0.0484(0.99)
INF, RER	46	2.2767(0.07)	2.0474(0.10)	1.5916(0.19)	1.4341(0.24)
RER, INF	46	3.1918(0.02)	3.3703(0.01)	3.7243(0.01)	3.2706(0.02)
NEXP, RER	46	0.0255(0.99)	0.8803(0.48)	0.8056(0.52)	0.9041(0.47)
RER, NEXP	46	4.1359(0.00)	2.4981(0.05)	2.3415(0.07)	3.1895(0.02)
ETDT, RER	46	0.7254(0.58)	1.4454(0.23)	1.1004(0.57)	1.2787(0.29)
RER, ETDT	46	2.5573(0.05)	2.3111(0.07)	1.9044(0.12)	1.5949(0.19)

Notes: obs. is number of observations; figures in bracket are probabilities
Source: Computed

As could be seen, real interest rate (RIR), inflation (INF), non-oil exports (NEXP) and external debt (ETDT) exhibited significant relationships with the unweighted RER. Except for the case of inflation that recorded a bidirectional relationship, the causalities were unidirectional; RIR Granger-caused the RER; RER Granger-caused non-oil exports and external debt. Thus, the unweighted RER was a cause of changes in the price level, non-oil exports and external debt in the period under consideration. Except for the case of external debt and the reverse causality of inflation on RER that were only significant at 10%, all others were at 5%.

With the trade weighted RER (REERGW), four cases of significant relationship were also recorded; they were real interest rate, inflation, non-oil exports and external debt. All were unidirectional with REERGW Granger-causing all except RIR. The REERGW - NEXP and REERGW-ETDT results were only significant at 10% while the remaining two were significant at 5%.

Under the export weighted REER (REERGX), unidirectional causality relationship was found with inflation and external debt. The order of causality was from REERGX to each of the variables. While the inflation result was at 5%, that of non-oil exports was at 10%. Bidirectional causality was recorded between RIR and REERGX with both significant at 10%.

In the case of the import weighted REER (REERGM), causality relationship was established with two variables, inflation and non-oil exports.The relationships were unidirectional and of the order of REERGM to each of the variables. The causality was established at 5% in both cases.

Overall, the level causality analyses suggested that RER, weighted or not, consistently and unidirectionally Granger-caused inflation and non-oil exports and with the exception of REERGX and REERGM, it Granger-caused external debt too. The results under both the unweighted RER and the import weighted REER showed stronger relationships in terms of strength of significance.

To facilitate the causality analysis at the order of integration, a unit root test was necessary. The tests conducted according to the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) procedures are reported below in Table 4.

Table 4
UNIT ROOT TESTS

Variable	ADF		PP		Remarks
	Level	1st Diff.	Level	1st Diff.	
RER	-2.2528(0.19)	-6.0429(0.00)	-2.2528(0.19)	-6.0128(0.00)	I(1)
REERGW	-2.8550(0.05)	-5.4078(0.00)	-2.1299(0.23)	-5.2933(0.00)	I(1)
REERGX	-3.0810(0.03)	-5.4006(0.00)	-2.5477(0.11)	-5.2294(0.00)	I(1)
REERGM	-2.9414(0.04)	-5.5548(0.00)	-2.2573(0.18)	-5.4208(0.00)	I(1)
INF	-4.0819(0.00)	-	-3.3591(0.017)	-	I(0)
RIR	-3.8237(0.00)	-	-3.6507(0.00)	-	I(0)
NEXP	1.3410(0.99)	-5.5918(0.00)	0.9597(0.99)	-5.6665(0.00)	I(1)
RGDP	0.9378(0.99)	-5.5471(0.00)	0.7493(0.99)	-5.5531(0.00)	I(1)
ETDT	-0.5700(0.86)	-5.3042(0.00)	-0.6145(0.85)	-5.3042(0.00)	I(1)
FDI	-6.1535(0.00)	-	-6.1716(0.00)	-	I(0)

Sample: 1962-2011
Source: Computed

The table shows that inflation, real interest rate and foreign direct investment were stationary at level while all others were I(0) series. The causality tests corresponding to the order of integration are presented in Table 5. (Econometrically, level stationary series contain long run information and also preclude spurious estimates. The justification for including them in the short run analysis [causality] is similar to that of error correction model - they could also be of relevance in the short run given that a long run series may be an average of several short run series).

Table 5
THE CAUSALITY RESULTS – ORDER OF INTEGRATION
Sample: 1962-2011
Lags: 4

Null Hypothesis	Obs.	F Statistics			
		RER	REERGW	REERGX	REERGM
RIR, ΔRER	45	3.6776(0.01)	3.4576(0.01)	2.7381(0.04)	2.7936(0.04)
ΔRER, RIR	45	1.2435(0.13)	1.5351(0.21)	1.6980(0.17)	1.3375(0.27)
ΔRGDP, ΔRER	45	0.5655(0.68)	0.5495(0.70)	0.6023(0.66)	0.5740(0.68)
ΔRER, ΔRGDP	45	0.6417(0.63)	0.6359(0.64)	0.5517(0.69)	0.4366(0.78)
FDI, ΔRER	45	0.0604(0.99)	0.0347(0.99)	0.1055(0.97)	0.0792(0.98)
ΔRER, FDI	45	0.2948(0.87)	0.0830(0.98)	0.1012(0.98)	0.1436(0.96)
INF, RER	45	3.1165(0.02)	2.4915(0.06)	2.0259(0.11)	2.0677(0.10)
ΔRER, INF	45	2.5605(0.05)	2.7079(0.04)	2.9609(0.03)	2.5350(0.05)
NEXP, RER	45	2.1596(0.09)	1.7933(0.15)	1.5860(0.19)	1.5678(0.20)
ΔRER, NEXP	45	3.6119(0.01)	2.7666(0.04)	2.5923(0.05)	3.6294(0.01)
ΔETDT, ΔRER	45	1.0465(0.39)	1.0915(0.37)	1.0333(0.40)	0.8898(0.47)
ΔRER, ΔETDT	45	1.5230(0.21)	1.1840(0.33)	0.9743(0.43)	0.7113(0.58)

Source: Computed

Three significant causality relationships were recorded under the unweighted RER; these were RIR, INF and NEXP all at the 5% significance level. Except for the RIR case that was unidirectional, all were bidirectional with RER granger causing in the latter two cases. The case of REERGW was also similar except that the causality with NEXP was unidirectional. Whereas, the INF - REERGW causality was significant at 10%, the reverse was at 5%. Both the REERGW - NEXP and the RIR - RER causalities were significant at 5%. The REERGX results suggested causality with RIR, INF and NEXP with all being unidirectional. REERGX Granger-caused INF and NEXP at 5% and 10% respectively while in turn, was Granger-caused by RIR at 5%. The results involving REERGM were similar to those of REERGX except for the fact that the REERGM - INF result was only significant at 10%.

Comparatively, in the case in which the order of integration of variables were taken into consideration, external debt appeared to drop out of the league of variables having significant causality relations with the different measures of real effective exchange rate. Whereas, the level causality results for NEXP were found to be consistent, the causality test outcomes involving the RIR and INF were more consistent and robust under the order of integration.

Table 6					
SUBSAMPLE'S CAUSALITY RESULTS – LEVEL ESTIMATES					
Sample: 1973-1980; 1999-2007					
Lags: 4					
Null Hypothesis	Obs.	F Statistics			
		RER	REERGW	REERGX	REERGM
RIR, RER	13	3.0092(0.15)	3.3589(0.13)	2.1618(0.23)	2.8797(0.16)
RER, RIR	13	25.5313(0.00)	4.7421(0.08)	5.1966(0.06)	1.1188(0.45)
RGDP, RER	13	0.7430(0.60)	0.4992(0.74)	0.2475(0.89)	0.6876(0.63)
RER, RGDP	13	1.6441(0.32)	0.5085(0.73)	0.3229(0.85)	0.6005(0.68)
FDI, RER	13	6.4417(0.04)	109.385(0.00)	76.2997(0.00)	40.6888(0.00)
RER, FDI	13	1.1907(0.43)	0.0709(0.98)	0.0625(0.99)	0.1884(0.93)
INF, RER	13	3.6561(0.11)	9.1857(0.02)	9.2677(0.02)	1.4474(0.36)
RER, INF	13	1.2185(0.42)	1.3075(0.40)	1.3829(0.38)	0.6072(0.67)
NEXP, RER	13	0.6219(0.67)	0.5069(0.73)	0.2061(0.92)	0.3644(0.82)
RER, NEXP	13	1.4280(0.36)	0.6293(0.66)	0.3416(0.83)	0.3156(0.85)
ETDT, RER	13	0.2793(0.87)	0.3985(0.80)	0.3793(0.81)	0.4491(0.77)
RER, ETDT	13	0.9789(0.50)	0.5466(0.71)	0.5168(0.73)	0.3632(0.82)

Source: Computed

Under the unweighted RER, two causality results were recorded: RIR and FDI, both unidirectional and of the order of RER to RIR but FDI to RER. Whereas, the RER – RIR result was significant at 1%, that of FDI - RER was significant at 5%. With REERGW, inflation too showed a causal relationship that is, in addition to what obtained under REER. The relationship was unidirectional and ran from INF to REERGW. It was significant at 5%. FDI was significant at 1% while RIR was only at 10%. The results under REERGX were replica of those under REERGW. However, with REERGM, only FDI exhibited significant causal relation with the exchange rate variable and the level of significance was 1%. Clearly, FDI was the more consistent causality outcome with all the measures of real exchange rate under the level estimates of the subsample.The outcomes of the unit root investigations of the subsample were as presented in Table 7.

Table 7					
UNIT ROOT TESTS					
Sample: 1973-1980; 1999-2007					
Variable	ADF		PP		Remarks
	Level	1st Diff.	Level	1st Diff.	
RER	-2.2479(0.19)	-3.9551(0.01)	-2.2479(0.19)	-3.9689(0.00)	I(1)
REERGW	-1.3577(0.57)	-3.4351(0.02)	-1.3577(0.57)	-3.4188(0.02)	I(1)
REERGX	-1.5144(0.50)	-3.5311(0.02)	-1.5144(0.50)	-3.5158(0.02)	I(1)
REERGM	-1.3415(0.58)	-3.7517(0.01)	-1.3220(0.59)	-3.8290(0.01)	I(1)
INF	-2.5686(0.11)	-3.8643(0.01)	-2.5686(0.11)	-5.2767(0.00)	I(1)
RIR	-1.6825(0.42)	-4.3207(0.00)	-1.6825(0.42)	-5.7168(0.00)	I(1)
NEXP	-0.8010(0.79)	-4.0531(0.00)	-0.7380(0.80)	-4.0728(0.00)	I(1)
RGDP	-0.8273(0.68)	-3.9097(0.01)	-0.8118(0.78)	-3.7241(0.01)	I(1)
ETDT	-1.1041(0.68)	-3.7245(0.01)	-1.1041(0.68)	-3.7241(0.01)	I(1)
FDI	-3.5617(0.01)	-	-3.5617(0.01)	-	I(0)

Source: Computed

The table shows that apart from FDI that was stationary at level, all others were I(1) series. The unit root outcomes constituted the basis of the causality tests reported in Table 8.

Table 8					
SUBSAMPLE'S CAUSALITY RESULTS – ORDER OF INTEGRATION					
Sample: 1973-1980; 1999-2007					
Lags: 4					
Null Hypothesis	Obs	F Statistics			
		RER	REERGW	REERGX	REERGM
ΔRIR, ΔRER	12	5.4059(0.09)	0.9415(0.54)	1.0905(0.49)	0.7819(0.60)
ΔRER, ΔRIR	12	12.0997(0.03)	1.8820(0.31)	1.9289(0.30)	1.3245(0.42)
ΔRGDP, ΔRER	12	0.5708(0.70)	0.5551(0.71)	3.7185(0.15)	0.7348(0.62)
ΔRER, ΔRGDP	12	1.2694(0.43)	0.6720(0.65)	6.7485(0.07)	0.8423(0.57)
FDI, ΔRER	12	3.5987(0.16)	86.337(0.00)	41.666(0.00)	21.851(0.01)
ΔRER, FDI	12	0.7530(0.61)	0.6702(0.65)	0.6576(0.66)	1.2555(0.44)
ΔINF, ΔRER	12	4.2991(0.13)	4.1760(0.13)	4.4436(0.12)	1.6636(0.35)
ΔRER, ΔINF	12	5.6820(0.09)	3.9543(0.14)	4.8260(0.11)	2.8989(0.20)
ΔNEXP, ΔRER	12	0.5746(0.70)	0.5578(0.71)	2.1589(0.27)	0.5206(0.73)
ΔRER, ΔNEXP	12	0.9894(0.52)	0.5791(0.70)	2.9287(0.20)	0.5837(0.69)
ΔETDT, ΔRER	12	0.1368(0.95)	0.2651(0.88)	0.2832(0.87)	0.1868(0.93)
ΔRER, ΔETDT	12	0.1809(0.93)	0.4608(0.76)	0.3557(0.82)	0.2259(0.90)

Source: Computed

Under the unweighted RER, causality was established with RIR and INF; the first was bidirectional with the RIR - RER result significant at 10% while the reverse was at 5%. The second, that is, involving inflation was unidirectional with RER granger causing; the result was only significant at 10%. In the case of REERGW, only FDI was significant and unidirectional; FDI Granger-caused REERGW at 1%. With REERGX, two causality results were established: RGDP and FDI, both unidirectional. REERGX Granger-caused RGDP at the 10% level of significance, while FDI Granger-caused REERGX at 1%. The results of REERGM suggested that only FDI Granger-caused the exchange rate variable at the 1% significance level.

CONCLUDING OBSERVATIONS

Regardless of the form of the data series employed (that is whether at level or order of integration) non-oil exports (NEXP) was the variable consistently explained by real exchange rates under the full sample. There was no dissent among the weighted RERs on this conclusion but the unweighted RER was inconsistent. The implication of this is that a properly aligned RER (weighted) would promote the growth of non-oil exports in the country.

Another result worthy of note under the full sample was the fact that the real interest rate was generally found to Granger-cause the real exchange rates (weighted or not). This appeared to be consistent with the established theoretical view that increases in nominal interest rate with a constant price level or falling price level with unchanged nominal interest rate, causes an appreciation of the real exchange rate via capital inflow. However, this relationship between RIR and RER was more consistent under the level estimates.

A result that forcefully emerged from the analysis of the subsample (level or order of integration) in the study was that foreign direct investment Granger-caused real exchange rates. Given the well-known economic development during the period of the subsample, it appeared that the oil boom improved the credit rating of the country significantly and induced capital inflows that had implications for the real exchange rates. Going by the established theoretical view that capital flow is a long run driver of real exchange rate, the need for policy attention to the level of real exchange rate in a period of an oil export boom appears quite clear. Other

indicators of performance that displayed some causal relations with real exchange rate especially under the order of integration were inflation and real gross domestic product.

Finally, it appears that the choice of weight for the real exchange rate would be distinctive to a country. As the results in this study indicated, the export weighted REER posted superior performance during the periods of oil boom in the country. However, as a 'going-concern' economy (that is, the long term view of the RER), the unweighted RER appeared to tower above the others. Generally, there was little evidence from the study that allowing for order of integration in causality analysis would consistently yield superior results. Nonetheless, the approach appears to have econometrics on its side.

In conclusion, there is scope for further studies in this line of research. As recommended in the literature, choosing a median period as the base year in the construction of the real effective exchange rate indices could produce more economically relevant results. In this study, a period such as 1990 would appear to generally qualify for such a consideration. However, there would be need to ensure that the variations of the two series are indeed different. Finally, although a fallout of this study is the likelihood that the choice of an appropriate RER weight might be distinctive to a country, a generalized view would only result from widespread analysis of other countries' data.

REFERENCES

Edwards S (1989) *Real exchange rates, devaluation and adjustment: Exchange rate policy in developing countries*. MIT Press, Cambridge Mass.

Edwards S & M Aoki (1983) Oil export boom and 'Dutch Disease': A dynamic analysis. *Resource and Energy Economics*, 5(3),219-242.

Frenkel J & M Goldstein (1988) Exchange rate volatility and misalignment: evaluating some proposals for reform. In *Financial Market Volatility*, A Symposium sponsored by the Federal Reserve of Kansas City, 185-220.

Granger CWJ (1969) Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 37(3),424-438.

Harberger A (1986) Economic adjustment and the real exchange rate. In Edwards S. & L. Ahmed (eds.) *Economic Adjustments and Exchange rates in Developing Countries* (pp. 371-414). Chicago: University of Chicago Press.

Koch E (1984) The measurement of effective exchange rates. *Bank of International Settlement Working Paper* no. 10: Basle.

Pinto B (1987) Nigeria during and after the oil boom: A policy comparison with Indonesia. *World Bank Economic Review*, 1(3),419-445.

Rodrik D (2008) The real exchange rate and economic growth. Harvard University: www.hks.harvard .edu/fs/drodrik/Research%20papers/RER%20…

Rosensweig J (1987) Exchange rate index construction with a US dollar application. *Journal of Foreign Exchange and International Finance*, 1(3),293-301.

Salter W (1959) Internal and external balance: The role of price and expenditure effects. *Economic Record*, 35(71), 227-238.

Swan T (1956) Economic growth and capital accumulation. *Economic Record* 32(2),344-361.

OLIGOPOLISTIC MARKET AND VALUE OF WAITING

Yasunori Fujita, Keio University

ABSTRACT

Constructing a multi-stage stochastic Cournot model where each firm faces market uncertainty expressed by the geometric Brownian motion, we examine the effect of an increase in the market uncertainty on the optimal timing of the entry. It is revealed that when the market uncertainty is more than a threshold level, an increase in the market uncertainty accelerates the optimal timing of firms' entry, even if the market uncertainty is formulated by the geometric Brownian motion, which is in sharp contrast to the standard result that an increase in the uncertainty postpones the optimal timing.

Keywords: Cournot competition,Optimal stopping theory, Geometric Brownian motion, Value of waiting.

JEL Code: C61, D43

INTRODUCTION

Studies on the optimal timing of investment in a stochastic economy have entered a new stage since Nishimura and Ozaki (2007) introduced the Knightian uncertainty successfully to reverse the standard result of McDonald and Siegel (1986), Dixit and Pindyck (1994) and so on, which was derived by assuming the geometric Brownian motion. More precisely, Nishimura and Ozaki (2007) demonstrated that an increase in the Knightian uncertainty accelerates the optimal timing of investment for an infinite life-time project. Similarly, Trojanowska and Kort (2010), assuming the Knightian uncertainty as in Nishimura and Ozaki (2007), revealed that result of Nishimura and Ozaki (2007) holds also for an investment for a finite life-time project.

The present paper attempts to push forward these studies by combining the optimal stopping theory with the oligopolistic market theory as in Fujita (2007,2008,2016) and so on. That is, we construct a multi-stage stochastic Cournot model where each firm faces market uncertainty expressed by the geometric Brownian motion, to examine the effect of an increase in the market uncertainty on the optimal timing of the entry.

It is revealed that when the market uncertainty is more than a threshold level, an increase in the market uncertainty accelerates the optimal timing of firms' entry, even if the market uncertainty is formulated by the geometric Brownian motion, which is in sharp contrast

to the standard result that shows an increase in uncertainty postpones the optimal timing.

Structure of this paper is as follows. After constructing a basic model to derive the Cournot equilibrium in Section 2, section 3 formulates the objective function of each firm. Based on these analyses, in section 4 we demonstrate the relationship between an increase in the market uncertainty and the optimal timing of the entry. Concluding remarks are made in section 5.

BASIC MODEL

Let us consider a stochastic oligopolistic market that consists of n identical firms that engage in two stage game in an infinite time horizon, where each firm determines the optimal timing of the entry in the first stage, followed by the second stage that determines the Cournot equilibrium in each period after the entry. We assume that each firm incurs an entry cost of K and has a constant marginal cost of c. We also assume that time passes continuously with importance of the future diminishing with discount rate ρ.

Letting $x_i(t)$ and $p(t)$ denote the ith firm's output and the unit price of the product in period t, respectively, we assume $p(t)$ is related to the total output in period t, $Q(t) \equiv \sum_{i=1}^{n} x_i(t)$, through the following linear inverse demand function, $p(t)=a-b(t)Q(t)$, where a is a positive constant that indicates the choke price, while $b(t)$ is a positive variable that represents the size of the market in period t.

As a way of formulating the market uncertainty, we assume $b(t)$ to fluctuate stochastically according as the following geometric Brownian motion as in Fujita (2016),

$$\frac{db}{b(t)} = s dz, \tag{1}$$

with initial value b_0, where s is a positive constant that expresses the market volatility in a sense that larger s means more uncertainty of the market, while dz is Wiener process that expresses the random movement.

Following the standard procedure of the backward induction, let us first derive the equilibrium in the second stage, *i.e.*, the Cournot equilibrium in each period after the entry. Since the ith firm's profit in period t, $\pi_i(t)$, is described as $\pi_i(t)=(a-b(t)Q(t))x_i(t)-cx_i(t)$, we have the ith firm's first order condition for the profit maximization as $\frac{\partial \pi_i}{\partial x_i}=a-2b(t)x_i-b(t)\sum_{j\neq i} x_j - c = 0$ for every $i \in [1,n]$, to yield the ith firm's output in the Cournot equilibrium in period t as

$$x_i(t) = \frac{a-c}{(n+1)b(t)}. \tag{2}$$

FORMULATION OF THE OBJECTIVE FUNCTION

Since the *i*th firm's profit in the Cournot equilibrium in period *t* is derived from Equation (2) as $\pi_i(t)=\frac{(a-c)^2}{(n+1)^2 b(t)}$, we have its first derivative and second derivative as $\frac{d\pi_i}{db}=-\frac{(a-c)^2}{(n+1)^2 b(t)^2}$ and $\frac{d^2\pi_i}{db^2}=\frac{(a-c)^2}{2(n+1)^2 b(t)^3}$, respectively. Thus, by making use of Ito's lemma, we can express the stochastic process of the *i*th firm's profit as

$$\frac{d\pi_i}{\pi_i}=\mu dt+\sigma dz, \tag{3}$$

with initial value $\pi_0=\frac{(a-c)^2}{(n+1)^2 b_0}$, where $\mu=s^2$ and $\sigma=-s$.

By making use of this stochastic process of the *i*th firm's profit, let us express the *i*th firm's objective function to maximize in period 0, $V_i=E[\int_{t_i^*}^{\infty} e^{-\rho t}\pi_i(t)dt-e^{-\rho t_i^*}K]$, as a function of b_i*, the market size *b* in period t_i*, the period of the *i*th firm's entry. For this purpose, if we let $G(\pi_0)$ denote the expected value of one unit of the *i*th firm's profit in period t_i* (*i.e.*, the expected value of $e^{-\rho t_i^*}$) as a function of the initial profit π_0, the general solution to $G(\pi_0)$ is expressed as

$$G(\pi_0)=\alpha(\pi_0)^{\gamma_1}+\beta(\pi_0)^{\gamma_2}, \tag{4}$$

where $\gamma_1<0$ and $\gamma_2>0$ are solutions to the characteristic equation $\frac{\sigma^2}{2}x(x-1)-\mu x-\rho=0$, which is rewritten as $x(x-3)-\frac{2\rho}{s^2}=0$ by substituting $\mu=s^2$ and $\sigma=-s$ into it. If we let π_i* denote the *i*th firm's profit in period t_i*, it follows that $\alpha=0$ and $\beta=(\frac{1}{\pi_i^*})^{\gamma_2}$ since $G(\pi_0)$ satisfies $G(\infty)=0$ and $G(\pi_i^*)=1$.

By substituting $\alpha=0$ and $\beta=(\frac{1}{\pi_i^*})^{\gamma_2}$ into Equation (4) and letting γ denote γ_2, we obtain

$$G(\pi_0)=(\frac{\pi_0}{\pi_i^*})^{\gamma}, \tag{5}$$

where

$$\gamma=\frac{3+\sqrt{9+\frac{8\rho}{s^2}}}{2}. \tag{6}$$

Thus, we can derive the *i*th firm's objective function to maximize in period 0 V_i as $V_i=(\frac{\pi_0}{\pi_i^*})^{\gamma}[\frac{\pi_i^*}{\rho-s^2}-K]$, which is rewritten as

$$V_i = (\frac{b_i^*}{b_0})^{\frac{3+\sqrt{9+\frac{8\rho}{s^2}}}{2}} \{\frac{1}{\rho - s^2}\frac{(a-c)^2}{(n+1)^2 b_i^*} - K\}, \quad (7)$$

by substituting $\pi_0 = \frac{(a-c)^2}{(n+1)^2 b_0}$, $\pi_i^* = \frac{(a-c)^2}{(n+1)^2 b_i^*}$ and Equation (6) into $V_i = (\frac{\pi_0}{\pi_i^*})^{\gamma}[\frac{\pi_i^*}{\rho - s^2} - K]$.

OPTIMAL TIMING OF THE ENTRY

Now, we are ready to determine each firm's optimal timing of the entry in the first stage.

Since the model of the present paper is stochastic, the optimal timing is expressed by the cut off level of the market size *b*. Therefore, by differentiating Equation (7) with respect to b_i*and setting it to zero, we have the optimal cut off level of the market size *b* for each firm as

$$b^* = \frac{(a-c)^2}{K(n+1)^2}\frac{3s^2 + 4\rho - s\sqrt{9s^2 + 8\rho}}{4\rho(\rho - s^2)}, \quad (8)$$

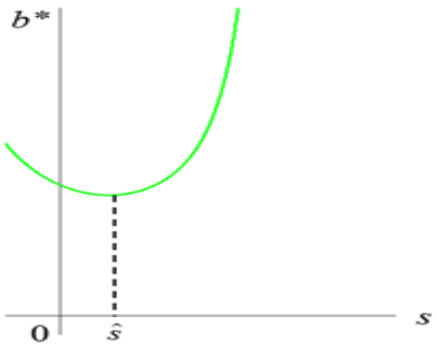
under the assumption of symmetric solution also for the timing of the entry, *i.e.*, $b_i^* = b^*$ for every $i \in [1,n]$.

Graph of b^* is depicted as a U-shaped curve on the *s*-b^* space as in **Figure1**, which is in sharp contrast with the standard result of the value of waiting where b^* decreases monotonically as *s* increases. To be exact, by differentiating Equation (8) with respect to *s* and setting it to zero, we have the threshold level of the market uncertainty $\hat{s}$ as

$$\hat{s} = \sqrt{\frac{\rho}{9 + 7\sqrt{2}}}. \quad (9)$$

Figure 1

RELATIONSHIP BETWEEN UNCERTAINTY AND THE TIMING OF ENTRY



Since large *s* means an increase in the market uncertainty and small (large) b^* means postponement (acceleration) of the entry, we have the following proposition.

Proposition: (1) If the market uncertainty is less than a threshold level, an increase in the market uncertainty postpones the optimal timing of firms' entry; (2) if the market uncertainty is more than a threshold level, however, an increase in the market uncertainty accelerates the optimal timing of firms' entry.

We can conclude from Proposition (2) that when the market uncertainty is more than the threshold level $\hat{s}$, what happens is in sharp contrast to the standard result even if we formulate the market uncertainty by the geometric Brownian motion.

In the present model, as Equation (3) shows, an increase in the market uncertainty pulls up the growth rate of each firm's profit, which results in accelerating the timing of the entry. If this accelerating effect surpasses the standard postponing effect, overall effect accelerates the timing of the entry. Proposition (2) demonstrates that such a case prevails if the market uncertainty is more than the threshold level $\hat{s}$.

CONCLUSIONS

We began this research wishing to contribute to the progress of studies on the economic education by inventing a model by combining the optimal stopping theory with the oligopolistic theory. Our result was more surprising than we had expected: when the market uncertainty is more than a threshold level, increase in the market uncertainty accelerates the optimal timing of firms' entry, even if we formulate the market uncertainty by the geometric Brownian motion.

We truly hope this research note, which tries to shed new light on the problem of the optimal timing, will contribute to better understanding of the theory of value of waiting, as well as to the progress of studies on the economic education.

REFERENCES

Dixit AK and RS Pindyck (1994) *Investment under Uncertainty*, Princeton University Press, Princeton, NJ.

Fujita Y (2007) Toward a New Modeling of International Economics: An Attempt to Reformulate an International Trade Model Based on Real Option Theory. *Physica A: Statistical Mechanics and its Applications*,383(2)507-512.

Fujita Y (2008) Competition and Welfare for a Stochastically Fluctuating Market with Irreversible Decisions. *Physica A: Statistical Mechanics and its Applications*, 387(12), 2846-2850.

Fujita Y (2016) Optimal Amount and Timing of Investment in a Stochastic Dynamic Cournot Competition.*Theoretical Economics Letters* 6(1),1-6.

McDonald R and Siegel D (1986) The Value of Waiting to Invest,*The Quarterly Journal of Economics*, 101,707-727.

Nishimura K and H Ozaki (2007) Irreversible Investment and Knightian Uncertainty.*Journal of Economic Theory* 136 (1),668-694.

Trojanowska M and P Kort (2010) The Worst Case for Real Options. *Journal of Optimization Theory and Applications* 146(3),09-734.

TEACHER JOB SATISFACTION IN CHARTER SCHOOLS

Mark Gius, Quinnipiac University

ABSTRACT

The purpose of this study is to examine teacher job satisfaction in charter schools. Using a large sample of teachers from the year 2011 and assuming that a teacher's choice to work in a charter school is exogenous, the results of this study suggest that teachers in charter schools are more enthusiastic, less willing to leave their jobs for better pay, and do not regret being teachers more so than regular public school teachers. However, if one assumes that a teacher's charter school status is endogenous, and then charter school teachers are generally less satisfied with their jobs and are more concerned about their job security than are regular public school teachers. This study is one of the few studies that examine the determinants of job satisfaction for charter school teachers, and it is the only study on this topic that assumes that charter school status may be endogenous.

INTRODUCTION

Charter schools have been in existence in the United States for over 25 years. Charter schools are publicly-funded schools that have significant autonomy and are not subject to the same regulations and bureaucratic structures that regular public schools are. Charters schools grew out of a desire to bring a more market-oriented approach to public education. The belief was that these schools, due to their significant autonomy, would be able to operate more effectively and efficiently than regular public schools. It was felt that this competition would force poorly-performing public schools to close, thus resulting in better educational experiences for all students. It was further felt that charter schools would have the most impact in urban areas where there are large populations of disadvantaged students. By giving these students an opportunity to attend a charter school, not only would their educational experiences improve, but the existence of these charter schools would also improve the educational experiences of all students in the community.

Given that charter schools have greater autonomy, it was also widely expected that not only would student satisfaction increase but that teacher satisfaction would increase as well. Since there are fewer restrictions on teachers and greater parental involvement, many believed that teachers would be much more satisfied working in charter schools than in regular public schools. In order to test this theory, the present study will compare teacher satisfaction in charter schools to teacher satisfaction in regular public schools.

LITERATURE REVIEW

Although there have numerous studies on teacher job satisfaction in public school settings (Gius, 2013; Moore, 2012; Belfield and Heywood, 2008; Liu and Ramsey, 2008; and Chapman and Lowther, 1982), there has been limited research on teacher satisfaction in charter public schools.

Regarding research on teacher satisfaction in general, one of the earliest studies was Chapman and Lowther (1982). Using a survey of 542 University of Michigan graduates who went on to become teachers, job satisfaction was defined as satisfaction with their current employer or satisfaction with their professional development. Two of the primary results of this study were that female teachers had greater job satisfaction than male teachers and recognition received from supervisors contributed to positive job satisfaction.

Liu and Ramsey (2008) looked at data from the Schools and Staffing Survey (SASS) and the Teacher Follow-Up Survey (TFS) for the years 1999-2001 in order to ascertain the factors that may affect teacher job satisfaction.The authors found that teachers, in general, were not satisfied with working conditions and that less experienced minority teachers were less satisfied than other teachers. According to their results, gender also played a role in teacher job satisfaction, although it varied depending upon the type of satisfaction examined.

Belfield and Heywood (2008) used data from SASS for the year 1999 in order to examine teacher job satisfaction. Using an ordered probit analysis, they found that male teachers who were union members and who worked in merit pay schools were less satisfied than other teachers.

Moore (2012) used data from the 2007-2008 SASS data set in order to determine if there was a relationship between school environment and teacher satisfaction. Looking only at public school teachers, the author found that experience and union membership were positively related to teacher job satisfaction, while African-American teachers, teachers in rural schools, and teachers in schools with greater percentages of minority teachers were less satisfied.

Finally, Gius (2013) looked at the effects of merit pay on public school teacher satisfaction. Using 2007-2008 SASS data, the author found that teachers in merit pay districts were less enthusiastic about their jobs, did not think teaching was important, and were more likely to leave for better pay.

Regarding teacher satisfaction in charter public schools, Bomotti, Ginsberg, and Cobb (1999) examined a sample of Colorado schools in order to compare teacher perceptions of work environments in regular public schools to perceptions of work environments in charter public schools. Their data is from a survey conducted in Colorado in the late 1990s. Using a factor analysis, the authors found some unexpected results. First, regular public school teachers overall felt more empowered than charter school teachers. This result contradicts some of the anecdotal evidence regarding teacher empowerment. However, it must be noted that charter school teachers felt more empowered in the classroom than regular teachers. Second, contrary to some research, there was no statistically significant difference in the job satisfaction of regular teachers and the job satisfaction of charter school teachers.

Renzulli, Parrott, and Beattie (2011) examined teacher satisfaction within a number of contexts, including racial disparities, school organizational structures, and charter schools. Using data from the 1999-2000 SASS, the authors found that charter school teachers have greater job satisfaction than regular public school teachers. The authors found that this result is due primarily to the greater autonomy allowed teachers in public schools.

The present study differs from the above research in several ways. First, much more recent data will be used; the present study will use data from the 2011 SASS. Second, this study will look at both regular public school teachers and charter school teachers. Third, this study will estimate two different models of teacher satisfaction, one assuming that charter school status (if the teacher is at a charter school) is exogenous and the other assuming that charter school status is endogenous. The empirical technique that is utilized in the present study is discussed in the next section.

EMPIRICAL TECHNIQUE AND DATA

Using prior research on teacher job satisfaction and worker satisfaction in general (Gius, 2013; Moore, 2012; Artz, 2010; Bryson, Cappellari, and Lucifora, 2010 and 2004; Garcia-Serrano, 2009; Belfield and Heywood, 2008; Liu and Ramsey, 2008; Gazioglu and Tansel, 2006; Donohue and Heywood, 2004; Hewood, Siebert, and Wei, 2002; Clark, 1997; Gordon and Denisi, 1995; Lillydahl and Singell, 1993; Meng, 1990; and Chapman and Lowther, 1982), the following model of job satisfaction was constructed using explanatory variables that capture both individual and job-related characteristics:

$$Y_i = \alpha_0 + \alpha_1 \text{ Male} + \alpha_2 \text{ Hispanic} + \alpha_3 \text{ African-American} + \alpha_4 \text{ White} + \alpha_5 \text{ Enrollment} + \alpha_6 \text{ Master's Degree} + \alpha_7 \text{ Advanced Degree} + \alpha_8 \text{ Student-Teacher Ratio} + \alpha_9 \text{ Minority Teachers} + \alpha_{10} \text{ Minority Students} + \alpha_{11} \text{ Experience} + \alpha_{12} \text{ Urban School} + \alpha_{13} \text{ Town School} + \alpha_{14} \text{ Suburban School} + \alpha_{15} \text{ Elementary School} + \alpha_{16} \text{ Middle School} + \alpha_{17} \text{ High School} + \alpha_{18} \text{ School Lunch} + \alpha_{19} \text{ West} + \alpha_{20} \text{ Midwest} + \alpha_{21} \text{ South} + \alpha_{22} \text{ Union} + \alpha_{23} \text{ Age} + \alpha_{24} \text{ Married} + \alpha_{25} \text{ Tenure} + \alpha_{26} \text{ Charter School}.$$

where Y_i denotes various measures of teacher job satisfaction. Definitions of the explanatory variables are presented on Table 1. Some of the explanatory variables were included in order to capture the effects of institutional-level characteristics on job satisfaction. These variables include student-teacher ratios, the racial composition of the school, the percentage of students receiving free or reduced-price lunches, whether or not the school grants tenure, the location of the school, and school enrollment.

Table 1 VARIABLE DEFINITIONS	
Variable	Definition
Male	1 if person is male; 0 otherwise
Hispanic	1 if person is Hispanic; 0 otherwise
African-American	1 if person is African-American; 0 otherwise
White	1 if person is white; 0 otherwise
Enrollment	Total school enrollment
Master's Degree	1 if teacher has a Master's degree; 0 otherwise
Advanced Degree	1 if teacher has advanced degree beyond Master's; 0 otherwise
Student-teacher Ratio	Student-teacher ratio
Minority Teachers	Percentages of teachers in school who are of a racial/ethnic minority
Minority Students	Percentages of students in school who are of a racial/ethnic minority
Experience	Teacher's years of experience
Union	1 if teacher is union member; 0 otherwise
Urban	1 if school is located in urban area; 0 otherwise
Town	1 if school is located in small town; 0 otherwise
Suburb	1 if school is located in suburban area; 0 otherwise
Elementary School	1 if elementary school; 0 otherwise
Middle School	1 if middle school; 0 otherwise
High School	1 if high school; 0 otherwise
School Lunch	Percentage of students approved for free or reduced-price lunches
Age	Age of teacher
Charter School	1 if school is charter; 0 otherwise
Tenure	1 if school has tenure system; 0 otherwise
West	1 if school is located in the West; 0 otherwise
South	1 if school is located in the South; 0 otherwise
Midwest	1 if school is located in the Midwest; 0 otherwise
Married	1 if teacher is married; 0 otherwise
Note: Base category in school classification is Combined (elementary, middle, and high school).	

Regarding the dependent variable, this paper uses six measures of satisfaction. Those measures are as follows:

(1) I am generally satisfied with being a teacher at this school.
(2) I do not worry about my job security.
(3) I am as enthusiastic about teaching as when I first started.
(4) I would not leave my school for a better paying job.
(5) I do not think about transferring to another school.
(6) If I could start over, I would still be teacher.

For the first five satisfaction measures, the four possible outcomes are "strongly agree", "somewhat agree", "somewhat disagree", and "strongly disagree." The responses to some of the above questions were reverse coded; in order to make the results consistent and easier to understand, the coding on all variables was revised so that "strongly agree" (3) means that the teacher was most satisfied and "strongly disagree" (0) means that the teacher was least satisfied. For the sixth satisfaction measure ("would still be teacher"), there are five possible outcomes, ranging from "certainly would become a teacher" to "certainly would not become a teacher."

All data used in the present study was obtained from the Schools and Staffing Survey (SASS) which is compiled by the US Department of Education. This survey, which is conducted

every three years, collects data on teachers, administrators, schools, and districts from a randomly-selected sample. The present study uses data from the 2011 SASS. Only full-time, public school teachers were included in the sample. Any teachers with missing data were excluded. The final sample contains data on about 36,120 teachers, of which 2,030 were charter school teachers. Sample sizes were rounded to the nearest ten due to the use of restricted data.

RESULTS

Given that the satisfaction variables are measured on a four or five-point scale, an ordered probit analysis was used to estimate the determinants of teacher job satisfaction. Regression results are presented on Tables 2 and 3. These results indicate that teachers in charter schools are more enthusiastic, less willing to leave their jobs for better pay, and do not regret being teachers more so than regular public school teachers.This evidence supports the hypothesis and anecdotal evidence that charter school teachers are more satisfied with their jobs than are public school teachers, holding all else constant.

Table 2
ORDERED PROBIT RESULTS

Variable	Generally Satisfied	Job Security	Enthusiastic
Constant	2.04 (36.94)***	1.543 (30.16)***	1.56 (30.23)***
Male	-0.019 (-1.41)	0.025 (1.97)**	0.062 (4.86)***
Hispanic	0.14 (3.24)***	0.143 (3.55)***	0.143 (3.49)***
African-American	0.10 (2.25)**	0.183 (4.36)***	0.0704 (1.66)*
White	-0.045 (-1.29)	0.101 (3.11)***	-0.066 (-1.99)**
Enrollment	0.00002 (1.89)*	0.000007 (0.63)	0.000016 (1.49)
Master's Degree	-0.045 (-3.43)***	-0.0017 (-0.14)	-0.044 (-3.61)***
Advanced Degree	-0.078 (-3.32)***	0.02 (0.91)	-0.031 (-1.38)
Student-teacher Ratio	-0.00012 (-0.08)	-0.0075 (-5.44)***	-0.0022 (-1.59)
Minority Teachers	-0.0023 (-5.14)***	-0.00096 (-2.30)**	-0.00089 (-2.11)**
Minority Students	-0.0023 (-8.85)***	-0.0017 (-6.89)***	-0.0011 (-4.62)***
Experience	-0.00012 (-0.08)	0.0134 (14.71)***	-0.0124 (-13.53)***
Union	-0.043 (-2.87)***	-0.114 (-8.12)***	-0.037 (-2.61)***
Urban	-0.024 (-1.29)	-0.0176 (-1.00)	-0.004 (-0.23)
Town	-0.017 (-0.91)	-0.033 (-1.96)**	-0.0096 (-0.56)
Suburb	0.0478 (2.73)***	-0.0543 (-3.37)***	0.061 (3.74)***
Elementary School	0.045 (1.87)*	-0.0388 (-1.74)*	0.018 (0.82)
Middle School	-0.034 (-1.48)	-0.091 (-4.34)***	-0.0427 (-2.02)**
High School	-0.116 (-5.30)***	-0.018 (-0.89)	-0.0528 (-2.57)**
School Lunch	-0.0031 (-11.45)***	-0.00433 (-17.16)***	-0.0015 (-6.02)***
Age	0.0029 (3.63)***	-0.0046 (-6.07)***	0.0023 (2.93)***
Charter School	-0.011 (-0.37)	0.033 (1.20)	0.087 (3.11)***
Tenure	0.081 (5.71)***	0.062 (4.71)***	0.064 (4.83)***
West	0.062 (2.69)***	0.15 (7.05)***	-0.161 (-7.45)***
South	0.0576 (2.70)***	-0.011 (-0.56)	-0.288 (-14.38)***
Midwest	0.0133 (0.67)	-0.031 (-1.71)*	-0.146 (-7.81)***
Married	0.0773 (5.65)***	0.052 (4.08)***	0.025 (1.95)*
Log-Likelihood	-35079.27	-47341.26	-47589.73

* 5%<p-value<10%; ** 1%<p-value<5%; *** p-value<1%; Test statistics in parentheses.

Table 3
ORDERED PROBIT RESULTS

Variable	Not Leave for Pay	Would not Transfer	Would Still be Teacher
Constant	1.34 (25.86)***	1.003 (18.87)***	2.119 (40.70)***
Male	-0.125 (-9.76)***	-0.0778 (-5.89)***	-0.0678 (-5.32)***
Hispanic	0.014 (0.34)	0.124 (2.94)***	-0.00054 (-0.01)
African-American	0.0524 (1.24)	0.081 (1.85)*	0.107 (2.48)**
White	0.083 (2.52)**	-0.0365 (-1.08)	-0.0528 (-1.58)
Enrollment	0.000013 (1.16)	0.00005 (4.77)***	0.000008 (0.67)
Master's Degree	-0.0159 (-1.29)	-0.08 (-6.24)***	-0.0338 (-2.74)***
Advanced Degree	-0.054 (-2.40)**	-0.197 (-8.54)***	-0.0805 (-3.63)***
Student-teacher Ratio	-0.0028 (-2.02)**	0.00172 (1.19)	-0.0051 (-3.66)***
Minority Teachers	-0.00118 (-2.80)***	-0.0015 (-3.38)***	-0.00042 (-0.99)
Minority Students	-0.00007 (-0.29)	-0.00212 (-8.49)***	0.00009 (0.40)
Experience	-0.00204 (-2.21)**	0.0137 (14.06)***	-0.0032 (-3.47)***
Union	0.046 (3.24)***	-0.0234 (-1.60)	-0.00703 (-0.50)
Urban	0.0535 (3.01)***	-0.00215 (-0.12)	0.0153 (0.86)
Town	0.015 (0.87)	0.0215 (1.19)	-0.0023 (-0.13)
Suburb	0.0896 (5.46)***	0.0686 (4.03)***	0.0373 (2.28)**
Elementary School	0.0494 (2.17)**	0.112 (4.76)***	0.0504 (2.22)**
Middle School	-0.0116 (-0.55)	-0.0164 (-0.75)	-0.029 (-1.37)
High School	-0.0289 (-1.40)	-0.0243 (-1.14)	-0.056 (-2.69)***
School Lunch	-0.00088 (-3.45)***	-0.00267 (-10.11)***	-0.00101 (-3.97)***
Age	0.0018 (2.35)**	0.0094 (11.74)***	-0.0027 (-3.53)***
Charter School	0.06 (2.15)**	-0.0642 (-2.25)**	0.076 (2.70)***
Tenure	0.0752 (5.65)***	0.106 (7.68)***	0.0742 (5.59)***
West	-0.193 (-8.85)***	-0.093 (-4.13)***	-0.0823 (-3.79)***
South	-0.33 (-16.35)***	-0.0525 (-2.51)**	-0.224 (-11.16)***
Midwest	-0.193 (-10.22)***	-0.0881 (-4.53)***	-0.0789 (-4.21)***
Married	0.0843 (6.53)***	0.092 (6.90)***	0.0472 (3.66)***
Log-Likelihood	-45834.62	-42828.71	-50449.99

* 5%<p-value<10%; ** 1%<p-value<5%; *** p-value<1%; Test statistics in parentheses.

Regarding results for the other explanatory variables, teachers who were married and who worked in schools that had a tenure system and had few minority teachers were more satisfied overall with their jobs than were other teachers. These results are consistent with prior research in this area.

One potential issue with the above analysis is that some teachers may be more inclined to work in charter schools. These teachers may have certain attitudes about teaching that may be reflected in their job satisfaction. In order to control for this possible endogeneity and to confirm the results obtained from the ordered probit analysis, a two-stage regression was used to estimate the effects of charter school employment on teacher job satisfaction. In this two-stage analysis, it was assumed that charter school status (whether or not a teacher works in a charter school) is endogenous.

An important issue in a two stage analysis is the selection of an appropriate instrument for charter school status. It is necessary that the instrument is exogenous in the estimation of charter school status and is uncorrelated with the error term in the second stage regression. It is assumed in this analysis that a variable denoting the percentage of schools in a state that are charter schools

is a reasonable instrument for the estimation of charter school status. This is because it is more likely that a teacher would work in a charter school if the there is a relatively large number of charter schools in a given state. It is also unlikely that this instrument is correlated with any measure of teacher job satisfaction. In the first stage of this regression, charter school status is regressed against a series of control variables, including the instrumental variable "percentage of schools in state that are charter schools." An ordered probit was used to estimate the second stage regression.

First stage regression results are available upon request. Second stage results are only reported for the charter school variable; these results are presented on Table 4. Full results are available upon request. These results indicate that, when the endogeneity of charter school status is taken into account, charter school teachers are less satisfied with their jobs than are regular public school teachers. More specifically, charter school teachers are less satisfied in general with teaching at their schools and they are more concerned about their job security. The other job satisfaction measures were not statistically related to charter school status. Hence, these results are contradictory to those obtained from the regressions that assume charter school status is exogenous. Given the widely varying prevalence of charter schools at the state level (the percentage of public schools in a given state that are charter schools ranges from a low of 0% to a high of 19% in the SASS data), it is reasonable to assume that charter school status is endogenous and is significantly affected by the prevalence of charter schools in a given state. First stage results validate this hypothesis and indicate that the percentage of schools in a given state that are charter schools is significantly and positively related to the likelihood that a teacher works in a charter school.

Table 4
SECOND STAGE RESULTSCHARTER SCHOOL VARIABLE

	Coefficient	Test Statistic	Log-Likelihood
Generally Satisfied	-0.183	-2.75***	-35075.55
Job Security	-0.296	-4.68***	-47331.03
Enthusiastic	0.0501	0.79	-47594.26
Not Leave for Pay	-0.082	-1.28	-45836.11
Would not Transfer	-0.038	-0.59	-42831.07
Would Still be Teacher	0.0045	0.07	-50453.64

* 5%<p-value<10%; ** 1%<p-value<5%; *** p-value<1%
Complete second-stage results and first-stage results are available upon request.

CONCLUDING REMARKS

Although a relatively new initiative in education, charter schools have become a mainstay of the American educational system. Charter schools are based on the notion that school choice would improve student achievement and the satisfaction of all stakeholders, including teachers. Since teachers and administrators in charter schools have much greater autonomy than in regular public schools, it was felt that teachers would be able to use innovative teaching techniques, thus providing their students with superior educational experiences. In addition, it was believed that the rise of charter schools would result in the closing or reform of many poorly performing public schools. With the closure of these underperforming schools, the educational experiences of all students in the district, even those not attending charter schools, would improve dramatically.

An important component of the charter school experiment is attracting and retaining highly motivated and talented teachers. In order to accomplish this and especially given that some charter schools do not grant tenure and the dismissal procedure for charter school teachers is somewhat more streamlined than it is for regular public school teachers, it is imperative that potential and current teachers view charter schools as very positive workplaces where job satisfaction is much higher than it is at regular public schools. Hence, an examination of teacher job satisfaction in charter schools is necessary in order to determine if these schools are being successful in creating positive work environments where the efforts of teachers are duly recognized and teacher job satisfaction is consistently above average in comparison to regular public schools. Unfortunately, teacher job satisfaction in charter public schools has not been extensively studied.

In order to rectify this situation, the purpose of the present study was to examine the determinants of teacher job satisfaction, focusing particularly on the difference in satisfaction between regular public school teachers and charter school teachers. Using an ordered probit analysis and assuming that charter school status is exogenous, results of the present study indicated that teachers in charter schools are more enthusiastic, less willing to leave their jobs for better pay, and do not regret being teachers more so than regular public school teachers.This evidence supports the hypothesis that charter school teachers are more satisfied with their jobs than are public school teachers.

An important issue with the above results, however, is that the empirical technique used assumes that charter school status is exogenous. Given that teachers with certain attributes may be more willing to work in charter schools, it may be possible that the choice to teach in a charter school is not random. Hence, in order to control for the possible endogeneity of charter school status, a two-stage model was also estimated. In contradiction to the first model, the results from the two-stage model suggested that teachers in charter schools are less satisfied with their jobs; specifically, charter school teachers are less satisfied in general with teaching and they are more concerned about their job security. This result suggests that charter schools may experience greater turnover rates, teacher absenteeism, and less engaged teachers than regular public schools. In addition, these behaviors do not contribute positively to the overall learning experience and may result in lowered academic performance and reduced post-graduation prospects for students in charter schools. This result is significant, especially given that proponents of school choice and charter schools typically claim that charter schools would increase the satisfaction levels of all stakeholders and would also result in increased academic performance on the part of students. Hence, if charter school status is not random, then it may be possible that charter school teachers are less satisfied than regular public schools teachers and that this lowered sense of satisfaction may result in reduced academic performance on the part of students, thus calling into question the very reason for the existence of charter schools. Given that this is the first study of its kind to examine charter school teacher job satisfaction in an endogenous framework, more research is warranted in this area.

REFERENCES

Artz, Benjamin (2010) The impact of union experience on job satisfaction. *Industrial Relations*, 49 (3), 387-405.

Belfield, Clive and John Heywood (2008) Performance pay for teachers: Determinants and consequences. *Economics of Education Review*, 27, 243-252.

Bomotti, Sally, Rick Ginsberg, and Brian Cobb (1999) Teachers in charter schools and traditional schools: A comparative study. *Education Policy Analysis Archives*, 22 (7), 1-22.

Bryson, Alex, Lorenzo Cappellari, and Claudio Lucifora (2010) Why so unhappy? The effects of unionization on job satisfaction. *Oxford Bulletin of Economics and Statistics*, 72 (3), 357-380.

Bryson, Alex, Lorenzo Cappellari, and Claudio Lucifora (2004) Does union membership really reduce job satisfaction. *British Journal of Industrial Relations*, 42 (3), 439-459.

Chapman, David and Malcolm Lowther (1982) Teachers' satisfaction with teaching. *The Journal of Educational Research*, 75(4), 241-247.

Clark, Andrew (1997) Job satisfaction and gender: Why are women so happy at work? *Labour Economics*, 4, 341-372.

Donohue, Susan and John Heywood (2004) Job satisfaction and gender: An expanded specification from the NLSY. *International Journal of Manpower*, 25(2), 211-234.

Garcia-Serrano, Carlos (2009) Job satisfaction, union membership, and collective bargaining. *European Journal of Industrial Relations*, 15 (1), 91-111.

Gazioglu, Saziye and Aysit Tansel (2006) Job satisfaction in Britain: Individual and job related factors. *Applied Economics*, 38, 1163-1171.

Gius, Mark (2013) The effects of merit pay on teacher job satisfaction. *Applied Economics*, 45 (31), 4407-4415.

Gordon, Michael and Angelo Denisi (1995) A re-examination of the relationship between union membership and job satisfaction.*Industrial and Labor Relations Review*, 48 (2), 222-236.

Green C and J Heywood (2008) Does performance pay increase job satisfaction? *Economica*, 75, 710-728.

Heywood J and X Wei (2006) Performance pay and job satisfaction. *Journal of Industrial Relations*, 48 (4), 523-540.

Heywood J, W Siebert and X Wei (2002) Job satisfaction and worker sorting: the case of union and government jobs. *Industrial and Labor Relations Review*, 55 (4), 595-609.

Lillydahl, Jane and Larry Singell (1993) Job satisfaction, salaries, and unions: The determination of university faculty compensation.*Economics of Education Review*, 12 (3),233-243.

Liu, Xiaofeng and Jase Ramsey (2008) Teachers' job satisfaction: Analysis of the teacher follow-up survey in the United States for 2000-2001. *Teacher and Teacher Education*, 24, 1173-1184.

Meng, Ronald (1990) The relationship between unions and job satisfaction. *Applied Economics*, 22(12), 1635-1648.

Moore, Cara (2012) The role of school environment in teacher dissatisfaction among U.S. public school teachers. *SAGE Open*,(1016) Renzulli, Linda, Heather Macpherson Parrott, and Irenee Beattie (2011) Racial mismatch and school type: Teacher satisfaction and retention in charter and traditional public schools. *Sociology of Education*, 84 (1), 23-48.

OPEN STANDARDS AND LICENSE CHOICE IN OPEN SOURCE SOFTWARE

Shuo Chen, State University of New York at Geneseo

ABSTRACT

Open standards are important in markets for Internet technology to ensure interoperability of software components across the Internet. Many applications of the Internet technology experience network effects.Owners of open source software may benefit from network effects and influence future standards development through their license choice. This study analyzes the data of 118 open source software projects that develop Internet technology to explore the relationship between open standards and the license choice made by software owners. It tests the hypothesis of standardization and the hypothesis of commercialization. Results of the statistical analysis show that programmers devote more efforts to Internet projects using nonrestrictive licenses due to the importance of network effects and standards development in Internet technology. Further investigation of a larger sample of all open source software projects shows that projects with the topic of Internet are more likely to choose nonrestrictive licenses than the restrictive ones, especially when the intended audience is developer or system administrator. The results lend support to the theory of network effects and the standardization hypothesis.

INTRODUCTION

Technological standards are technical specifications that determine the compatibility or interoperability of different technologies. Open standards, as opposed to proprietary standards, are standards that are freely and publicly available for implementation and use. Open standards enable interoperability of software components so that different devices and applications can work together across the Internet. Open standards have stimulated innovations in the Internet technology and have led to the growth of new business areas such as e-Commerce, automation of data processing, and cloud services.

Many products and services of the Internet technology experience network effects. Network effects occur when the value of a product to an individual user increases with the number of the other users. The existence of network effects makes standards particularly important in markets for Internet technology. According to the Internet Society, a non-profit and professional organization that determines and publishes many open standards for the Internet (http://www.internetsociety.org, accessed on November 5, 2015), a technology is more likely to become a standard if it is widely used. And a technology will gain more users after it is established as a standard. The additional benefits of becoming a standard include the capability to affect the direction of future standards development (Gamalielsson et al., 2015).

Open standards and open source software are closely related. The source code of open source software is free for users to access, modify, and redistribute. Open standards reduce the risk of lock-in among different open source technologies and enable collaborative development within open source communities. It is widely recognized that open source communities have

contributed significantly to the establishment of key standards for the Internet (see e.g. Bresnahan & Yin, 2007; Friedrich, 2011).

Ghosh (2005) argues that owners of an interoperable technology can control the development of the standard through licensing conditions that discriminate or exclude certain groups of users. Owners of an open source software can choose to release the software under an open source license that is approved by the Open Source Initiative (OSI). The open source licenses can be divided into two categories: restrictive and nonrestrictive. The restrictive license requires that modified versions of the open source code remain open and prohibits the mixing of open and proprietary code. That is, if a proprietary project incorporates code released under a restrictive license, then this project must also be distributed under the terms of the same license. This is called the "viral" nature of the restrictive license (Feller & Fitzgerald, 2002, p. 19). In contrast, the nonrestrictive license may or may not require the modified versions of the open source code be open and allows the mixing of open and proprietary code. Code released under nonrestrictive licenses can be incorporated into other code without affecting the openness of the incorporating project (see, e.g., Lerner & Tirole, 2002). GPL (General Public License) is an example of restrictive license and LGPL (Less General Public License) is an example of nonrestrictive license.

In the existing literature there are studies that discuss the relationship between open standards and licensing terms of technology. Gamalielsson et al. (2015) argue that permissive licensing terms involving zero royalty of patents are crucial for increasing software interoperability. Ghosh (2005) analyzes the use of LGPL license in an open source word processing software, OpenOffice, to argue that open standards should be compatible with open source licenses to promote competition in the market. Lerner and Tirole (2005) suggest that standards might be an important concern to open source projects in the area of Internet.

There are empirical studies that investigate the relation between license type and the success of open source software. The findings are mixed. Lerner and Tirole (2005) find that the restrictiveness of open source license has a negative impact on developer input. Stewart et al. (2006) find that nonrestrictive licenses tend to stimulate greater user interest. Subramaniam et al. (2009) find that restrictive licenses have a negative impact on developer input, but a positive impact on user interest.

This study explores the impact of open standards and network effects on the license choice made by open source software owners. It investigates a sample of open source projects that develop Internet technology since open standards and network effects are important to the market of Internet technology.This study finds a negative relationship between the restrictiveness of license and the developer effort in these projects.

The main contribution of this study is to provide empirical evidence to cast light on the impact of standards development on license choice in open source software. Prior studies have not tested the relations between standards and open source license. This study uses a unique sample of open source software aimed at developing Internet technology, which complements the prior empirical work on open source software.

We begin the next section by discussing hypotheses: the standardization (or network effects) hypothesis and the commercialization (or competitive advantage) hypothesis. We then present an empirical analysis of the projects focusing on Internet technology to test the above hypotheses. We further investigate how license choice in all open source projects might respond to project topic and intended audience. The paper is organized as follows. Section 2 discusses the

hypotheses that lay foundation for the empirical analysis. Section 3 describes the data. Section 4 presents results of regression analysis and section 5 concludes.

HYPOTHESES

In this section we develop competing hypotheses of programmer efforts as a response to the license choice of open source projects.

Internet technology is subject to network effects: the value of a technology to a user increases with the number of other users of the same technology. For example, the value of a social network website to a single user is limited if there are not many other users of the same website.

The network externality not only exists among users, but also exists between developers and users (Bresnahan & Yin, 2007). All else equal, a user will choose a technology with the most associated applications. A large number of developers indicates greater availability of future applications of the technology. Thus the user's utility increases with the number of developers. Similarly, developers will tend to put their effort into a technology that have the largest user group. A larger number of users increases the probability that a technology becomes a standard. The developers get rewards from standardization through increase in software usage, improvement in software interoperability, and influence on future development direction. The developers' utility thus increases with the number of users.

For open source software projects that develop Internet technology, the benefits of standardization are significant. For websites, e-Business, and cloud services to work, there must be compatibility and interoperability of different software modules and components. Open standards, by making standards freely available to the public, have reduced the hold-up problem between different technologies and greatly boosted innovations in the Internet technology.

The network externality between users and developers also exists in that developers of open source projects get feedback such as bug reports from users and fix the bugs. The quality of the projects therefore increase as more people use the software. Both the programmers and the users benefit from the continued improvement of the program. Some studies further argue that users of open source projects are also developers. In many cases, programmers create open source software for their own direct use (see Lundvall & Vinding, 2004; Von Hippel, 2002; Raymond, 2000).

Friedrich (2011) argues that the owner of a new technology can keep it private to gain competitive advantage, or to share it with the public by making it into a standard. Similarly, owners of open source projects can strategically choose license type to achieve their goals. They can choose restrictive licenses to keep all future contributions to the project open, preventing private firms from "hijacking" the open source technology (see Tirole & Lerner, 2002). The restrictive licenses thus gives the original innovators competitive advantage if they want to commercialize the open source project in the future. Alternatively, the owners can choose nonrestrictive licenses so that the spread and market acceptance is faster, which is crucial to establish a standard. The costs are that the earlier innovators may not receive contributions from private firms because they can keep their subsequent work private when incorporating open source code released under nonrestrictive licenses. For open source projects in Internet technology, the benefits of standardization may exceed the costs of lost contributions. For open source projects where commercialization is a more important goal, the benefits of fast spread may be smaller than the costs of being hijacked by private firms. To summarize, the creators of

open source technology will choose nonrestrictive licenses for the projects that are essential for establishing or implementing standards and choose restrictive license for projects that they plan to commercialize.

H1 *The standardization hypothesis. Programmers contribute more efforts to open source projects with nonrestrictive licenses to gain network externality and facilitate standards establishment.*

H2 *The commercialization hypothesis. Programmers contribute more efforts to open source projects with restrictive license to gain competitive advantage and facilitate future commercialization.*

DATA

The dataset are selected from projects listed on freshmeat.net. The website was started in year 1997 and had been the largest index of Linux, UNIX, and cross-platform software, mostly released under an open source license. In year 2009, all freshmeat.net projects were integrated into sourceforge.net, which is another repository of open source software. Subsequently freshmeat.net was renamed to freecode.com and is no longer updated since June 2014 due to low traffic levels (see http://freecode.com/about and https://sourceforge.net/blog/freshmeat-integration/ , accessed on December 1, 2015). This study uses the freshmeat data as of year 2009 to remove the impact of the lower activity level on freshmeat.net after the integration with sourceforge.net.

As of August, 2009, freshmeat.net contained approximately 44,000 projects, most of which conform to the Open Source Definition. Both qualitative and quantitative information is available for each of the projects. The qualitative variables include project title, author, license type, intended audience, programming language, development status, and topic of program. The topic of a program can be games/entertainment, Internet (including browsers, HTTP servers, and site management, etc.), Software Development (examples are compilers, bug tracking tools, and libraries), and Systems (examples are operating systems, system administration, and networking). The intended audience includes End user, Developer,System administrator, and others. According to the terms and provisions of each license, the license is restrictive if it is GPL (General Public License), and nonrestrictive otherwise.

The quantitative variables include age of the project, date of last update, date of last release, vitality score, popularity score, rating, and number of subscribers. The vitality score for a project is formulated to reward the number of releases and to punish the days elapsed since last release. The popularity score takes into account of the number of record hits, the number of URL hits, and the number of subscriptions, where record hits is the number of accesses to the project page hosted at Freshmeat.net, and URL hits is the number of accesses for every URL associated with a project that leads off of freshmeat.net to the download site of the project.

A lot of projects are listed with multiple intended audience and multiple topics. We select the projects with single intended audience and single topic. Thus 16442 projects are left in the sample, among which 118 projects have the topic of Internet. Table 1 lists the means and standard deviations of the quantitative variables.

Table 1
DESCRIPTIVE STATISTICS

	Sample of all projects		Subsample of Internet projects	
	Mean	S. D.	Mean	S. D.
Added (days ago)	1139	634	787	474
Last release (days ago)	1033	639	589	384

Vitality score	2.99	4.2	4.7	5.2
Popularity score	102	84	141	91
Number of subscriptions	2.7	4.2	4.8	4.7

METHODOLOGY AND RESULTS

We first investigate the sample of 118 open source projects developing Internet technology. We want to know in the area of Internet technology whether innovative efforts are allocated towards the projects using nonrestrictive licenses, controlling for age, current popularity, and intended audience of the projects.

To test the relation between programmer efforts and license choice, we estimate the following equation:

$$Vitality = \beta_0 + \beta_1 Age + \beta_2 Popularity + \beta_3 SA + \beta_4 EU + \beta_5 DE + \beta_6 License, \quad (1)$$

where Age is the days between the date of the first publication of the project and August 1, 2009 and Popularity is the score reflecting the number of hits and subscriptions. SA, EU, and DE represent three types of intended audience: System Administrator, End User, and Developer. License is equal to one if the project uses a restrictive license (GPL) and zero otherwise. The vitality score, which reflects the frequency of new releases, is a proxy for the programmer efforts devoted to the project. The vitality score for a project is calculated as:

$$\text{vitality score} = \frac{\text{number of releases} * \text{age}}{\text{days since last release}}.$$

Table 2 lists the results of three regressions. Regression 1 in Table 2 shows the results of the regression of vitality score against age and popularity score. The estimated coefficient of Popularity is 0.02 (significant at the 1% level), indicating that the vitality of a project is positively related to its popularity. This suggests that more effort is devoted to the more popular projects. Therefore innovative effort is distributed efficiently towards widely used software.

Table 2
REGRESSION OF PROGRAMMER EFFORT AGAINST LICENSE TYPE [a]

	Regression 1	Std Error	Regression 2	Std Error	Regression 3	Std Error
Intercept	-0.19	(1.05)	-1.08	(1.13)	-0.11	(1.25)
Age	0.003*	(0.0009)	0.003*	(0.0009)	0.003*	(0.0009)
Popularity	0.02*	(0.001)	0.02*	(0.005)	0.02*	(0.005)
System Admin			3.59**	(1.62)	3.64**	(1.60)
End User			1.28	(1.06)	1.54	(1.06)
Developer			1.05	(1.46)	0.87	(1.45)
License					-1.59***	(0.90)
R^2	0.18		0.22		0.25	
Adjusted R^2	0.17		0.19		0.21	

*Significant at the 1% level **Significant at the 5% level ***Significant at the 10% level

a. These regressions use the subsample of 118 projects, for which the topic is Internet. The dependent variable is vitality score; standard errors are reported in parentheses.

Regression 2 in Table 2 includes three intended audience dummies: System Administrator, End User, and Developer to check if there is a difference in the effort devoted to projects geared toward different audiences among all Internet projects. The estimated coefficient of System Administrator is 3.59 (significant at the 5% level), indicating that there are more releases if the Internet project is aimed at system administrators. Programmers developing Internet technology publish more releases to system administrators than to audience in the baseline group, which includes advanced end users, quality engineers, and other audiences.

Regression 3 in Table 2 includes the license dummy to check the relationship between license type (equal to one if restrictive) and programmer effort. By the standardization hypothesis, there should be a negative relationship between license type and vitality. Contrarily, by the commercialization hypothesis, the relationship should be positive. In Regression 3 the estimated coefficient of the license dummy is significant and negative (-1.59). The results lend support to the standardization hypothesis. More effort is allocated to Internet projects under nonrestrictive licenses. This indicates that getting a larger number of users might be more important for these projects, even if there are risks of being "hijacked" by the private firms. For projects developing Internet technology, getting market acceptance is important for future standardization.

Next we use the whole sample of 16,442 open source projects to investigate the relation between various project topic and license choice. By the standardization hypothesis, projects with the topic of Internet tend to use nonrestrictive licenses. We use logistic regressions to test the hypothesis, where the dependent variable is the license dummy that is equal to one if the project is under a restrictive license (GPL), and zero otherwise. Table 3 lists the regression results.

Table 3
REGRESSION OF LICENSE TYPE AGAINST TOPIC AND INTENDED AUDIENCE [a]

	Regression 1	Std Error	Regression 2	Std Error	Regression 3	Std Error
Intercept	0.58*	(0.04)	0.46*	(0.04)	0.63*	(0.04)
Age	0.0003*	(0.00004)	0.0007*	(0.00003)	0.0003*	(0.00004)
End User	0.92*	(0.05)			0.96*	(0.05)
Developer	-1.11*	(0.06)			-1.17*	(0.06)
System admin	0.03	(0.09)			0.01	(0.09)
Desktop			-0.68*	(0.17)	-1.07*	(0.22)
Internet			-0.52*	(0.19)	-0.48***	(0.26)
Utility			0.07	(0.11)	0.23	(0.20)
Software			-1.27*	(0.12)	-1.53*	(0.37)
EU*Desk					0.07	(0.35)
EU*Int					-0.41	(0.47)
EU*Uti					-1.07*	(0.24)
Dev*Desk					1.35	(1.43)
Dev*Int					0.68	(0.62)
Dev*Uti					0.64	(0.51)
Dev*Soft					1.78*	(0.39)
SA*Int					0.06	(0.70)
SA* Uti					-0.18	(0.47)

*Significant at the 1% level **Significant at the 5% level ***Significant at the 10% level

a. The regression uses the full sample of 16,442 projects. The dependent variable is a dummy that is equal to one if the project is under a restrictive license (GPL), and zero otherwise; standard errors are reported in the parentheses.

Regression 1 in Table 3 reports the results of a logistic regression of license type against three Intended Audience dummies: System Administrator, End User, and Developer. The estimated coefficients of End User and Developer are 0.92 and -1.11, respectively (both significant at the 1% level), showing that projects geared towards end user tend to use restrictive licenses, while projects geared towards developer tend to use nonrestrictive licenses. This indicates that commercialization might be a more important goal for owners of open source projects aimed at end users, while network effects might be stronger for projects aimed at developers.

Regression 2 in Table 3 shows the results of a logistic regression of license type against four topic dummies: Desktop Environment, Internet, Utility, and Software Development. By the standardization hypothesis, there should be a negative relationship between license type and the topic of Internet. By the commercialization hypothesis, the relationship should be positive. In Table 3 Regression 2 the estimated coefficient of the Internet dummy is significant and negative (-0.52), providing support to the standardization hypothesis. Compared to projects in the baseline group with topics such as communications, multimedia, and others, projects with the topic of Internet are less likely to use restrictive licenses. The estimated coefficients of the Desktop dummy and the Software dummy are also significant and negative (-0.68 and -1.27, respectively), indicating that projects with topics of desktop environment and software development tend to use nonrestrictive licenses as well.

Regression 3 in Table 3 shows the results of a logistic regression of license type against intended audience, topic, and the interaction terms between them. The estimated coefficient of the topic of Internet is significant and negative (-0.48), indicating that projects with the topic of Internet is more likely to choose nonrestrictive licenses.

We summarize the results of Regression 3 in Table 3 to show the total effect of each variable on license choice. We get -0.97 for an Internet project aimed at developers by adding the coefficients of three variables: Internet (-0.48), Developer (-1.17), and the interaction term between Internet and Developer (0.68). Similarly, we get -0.41 for an Internet project aimed at system administrators, and 0.07 for an Internet project aimed at end users. This indicates that projects developing Internet technology tend to use nonrestrictive licenses when the intended audience is developer or system administrator. This finding is consistent with the standardization hypothesis. Internet projects tend to use restrictive licenses only when the intended audience is end user. This might be because projects aimed at end users have higher probability of future commercialization and will try to prevent the source code from being “hi-jacked” by private firms.

CONCLUSION

This study finds that for open source projects developing Internet technology, programmers devote more efforts to projects using nonrestrictive licenses. It also finds that projects with the topic of Internet are more likely to use a nonrestrictive license, especially when the intended audience is developer or system administrator. Both findings support network effects theory and the standardization hypothesis.

The main contribution of this research is in empirically testing the theory of the impact of open standards on open source license choice. It also complements earlier studies by analyzing a sample of open source projects focusing on Internet technology. It further uses logistic regressions to examine a larger sample of open source projects with various topics.

There are several limitations in this research that should be addressed in the future work. First, there are alternate theories to explain the license choice of open source projects, for example, the theory of signaling effects, i.e., programmers may get peer recognition and future job offers by working on open source projects (Lerner & Tirole, 2002). The regression results show that projects aimed at developers tend to use nonrestrictive licenses. This might indicate the existence of signaling effects. However, it is difficult to distinguish these effects using current data. Second, to understand the motivations behind programmers' decisions to devote their effort to a certain open source project, future research may need to collect subjective data. Third, future research need to better understand the mechanism for the emergence and establishment of new standards and the interactions between standards institutions and open source communities.

REFERENCES

Bresnahan TF & PLYin (2007) Standard setting in markets: The browser war. In S. Greenstein & V. Stango (Eds), *Standards and Public Policy* (pp. 18-59). Cambridge: Cambridge University Press.

Feller J & B Fitzgerald (2002) *Understanding open source software development*. London: Addison-Wesley.

Friedrich J (2011) Making innovation happen: the role of standards and openness in an innovation-friendly ecosystem.*Proceedings of the 7th International Conference on Standardization and Innovation in Information Technology*, 1-8.

Gamalielsson J, B Lundell, J Feist, T Gustavsson & F Landqvist (2015) On organisational influences in software standards and their open source implementations. *Information and Software Technology*, 67, 30-43.

Ghosh RA (2005) Open standards and interoperability report: An economic basis for open standards. Retrieved December 5, 2015, from http://www.flosspols.org/deliverables/FLOSSPOLS-D04-openstandards-v6.pdf

Lerner J & J Tirole (2002) Some simple economics of open source. *Journal of Industrial Economics*, 52, 197-234.

Lerner J & J Tirole (2005) The scope of open source licensing. *Journal of Law, Economics, and Organization*, 21(1), 20-56.

Lundvall B & AL Vinding (2004) Product innovation and economic theory - User-producer interaction in the learning economy. In JL Christensen & B. Lundvall (Eds), *Product Innovation, Interactive Learning and Economics Performance, Research on Technological Innovation and Management Policy (*pp. 101-128). Vol. 8. Bingley: Emerald Group Publishing Limited.

Raymond ES (2000) The cathedral and the bazaar (Revision 1.57). Retrieved November 20, 2015, from http://www.catb.org/esr/writings/cathedral-bazaar/cathedral-bazaar/

Stewart KJ, AP Ammeter & LM Maruping (2006) Impact of license choice and organizational sponsorship on success in open source software development projects. *Information System Research*, 17 (2), 126-144.

Subramaniam C, R Sen & ML Nelson (2009) Determinants of open source software project success: A longitudinal study. *Decision Support Systems*, 46(2), 576 - 585.

Von Hippel E (2002) Open source projects as horizontal innovation networks - By and for users. MIT Sloan Working Paper No. 4366-02.

THE GREAT DIGITAL DIVIDE: USING POPULAR MEDIA TO TEACH ECONOMICS

Abdullah Al-Bahrani, Northern Kentucky University
Kim Holder,University of West Georgia
Darshak Patel, University of Kentucky
Brandon J. Sheridan, Elon University

ABSTRACT

Economics instructors have increasingly embraced the use of popular culture as a teaching resource to enhance their lectures. The use of television shows, music and media clips presumably makes economic theories, concepts, and terms more relevant to today's students. For example, shows like The Simpsons, The Office, The Big Bang Theory, Seinfeld and many others have been suggested as great teaching tools for Economics due to students' familiarity with the content. We evaluate this claim by surveying students at three institutions over two years to identify which television shows and musicians are most popular with students. Our results indicate that the popular media frequently used by instructors are not always correspondingly popular with current students.

INTRODUCTION

The research on economic education in the past decade has provided economic educators with many innovative and diverse pedagogical methods. Becker and Watts (1996) found that the median economist spent about 83% of class time lecturing, leaving little time to incorporate alternative pedagogy. In a more recent paper, Watts and Schaur (2011) find that the median economist still spends about 83% of class time lecturing, although the average time lecturing fell from 73% to 65%, suggesting that there is a movement - albeit slowly - towards incorporating alternative teaching methods such as cooperative learning, flipped classrooms, and classroom experiments, among many others. One such innovation, and the focus of this study, is the use of popular media in the economics classroom. Economics educators have suggested that the use of popular media, especially television shows, movies and music, may help students learn economics better by connecting concepts to something with which students already have a frame of reference (Sexton, 2006; Mateer and Li, 2008; Gillis and Hall, 2010; Mateer, Ghent, and Stone, 2011; Al-Bahrani and Patel, 2015; Hall and Lawson, 2008).

The pedagogy tool of using popular media in economics classrooms is based on an assumption that students are familiar with the television shows and music that instructors use. However, we are not aware of any studies that formally survey students on their preferences. Therefore, we conduct a study across three institutions to gauge student preferences and match them with the resources currently available. We find that a "divide" exists between what instructors use and what is currently popular with students.

While economic educators have been somewhat flexible in trying new teaching methods, they may not be making the connection with the students based on the differences in what is considered "popular." Future students are digital natives; that is, they have always lived in a "connected" world. MTV is calling these generations "The Founders" - a group that do not know

a time before being consistently plugged in (Sanburn, 2015).This makes popular media a potentially useful resource to engage students in economics classrooms. In this paper, we examine student preferences to see if they align with the television and music resources currently available to economics educators.

There are currently several resources available for economics educators to use when incorporating television shows and music into their courses. Instructors are able to choose from shows like The Simpsons (Luccasen and Thomas, 2010), The Office (Kuester et al., 2014), The Big Bang Theory (Tierney et al., 2016), Seinfeld (Ghent, Grant, and Lesica, 2011), ESPN 30 for 30 (Al-Bahrani & Patel, 2015), Shark Tank (Acchiardo et al., 2016) and many others that are currently in the developmental stage. Often the claim is that these shows are popular amongst students and therefore can be leveraged for educational purposes. Our findings demonstrate that many of the most popular television shows among students do not currently have an accompanying resource devoted to illustrating the economics within the show. Thus, there is a so-called "divide" between what economics educators tend to choose to use to enhance their courses and what students actually watch regularly. While we cannot say with certainty, this divide is likely due to a number of plausible reasons, including differences in age, gender, tastes/preferences, and availability of media. In highlighting the divide, we hope to provide instructors with an extra resource to enhance their courses. Although we are aware that the popularity of the shows will continue to evolve over time, the purpose of the paper is to determine if there is currently a divide between faculty and student preferences. Our survey indicates there is a difference between the resources faculty currently have available and what students actually watch regularly; therefore, faculty need to think deliberately in terms of what shows/music to invest their time in if they wish to incorporate these resources into their courses.

LITERATURE

Economics educators have recently begun to embrace the use of popular media in the economics classroom. Harter (2003) and Hoyt (2003) have advocated for the use of popular media as a way to better connect with students, and to help explain economic concepts in ways that students understand. With the recent technological advancements, students are able to watch TV shows, movies, and music videos instantly from virtually anywhere. Faculty can enhance their courses by incorporating students' favorite popular media and connecting it with important course concepts. This form of engagement has the ability to increase students' learning and motivation (Harter, 2003).

Tinari and Khadke (2000) incorporate music within economics courses by assigning students a paper that required them to listen to music and connect the lyrics to economic concepts. This approach was further enhanced to include new and popular music (Mateer and Rice, 2007; Hall and Lawson, 2008; Hall, Lawson, and Mateer, 2008). An emerging student favorite across several institutions is Rockonomix - created by Holder et al. (2014). This is a student-produced music video parody project in which students pick a song, rewrite lyrics based on economics concepts, sing, and create an accompanying music video.

The use of TV clips within economics classrooms has also gained popularity recently. Clips from TV series such as The Simpsons (Gillis and Hall, 2010) and Seinfeld (Ghent et al., 2010) were first introduced to facilitate active learning projects. Since then, several other current shows have been introduced as resources for instructors to use to engage economics students including, but not limited to, The Office (Kuester et al., 2014), an ESPN series called ESPN 30

for 30 (Al-Bahrani & Patel, 2015), and popular CBS television sitcom The Big Bang Theory (Tierney et al., 2016).

These resources are currently being extended further through TV shows such as Shark Tank (Acchiardo et al., 2016) and Breaking Bad (Duncan, Muchiri, and Paraschiv, 2016). However, several concerns arise when thinking about the effectiveness of this pedagogy model. Though Economics has been open to incorporating popular media in the classroom, the assessment of how effective these methods are has lagged. It is important to critically evaluate if the assumptions we rely on hold in the context of an economics classroom. This paper does not conduct an experiment to test the efficacy of such pedagogy tools. However, we think a necessary precondition to measure the effectiveness of such tools is to first measure how popular the resources provided by the instructors are with students. Our findings help identify what resources to use and/or which ones to begin to develop. If one use of popular media is to connect with students, then we need to create resources that students are likely to consume, rather than only what is most popular with instructors - ideally, there will be overlap between them.

STUDY DESIGN

Data collection was conducted during two academic years. During the 2015-2016 academic year, the survey was administered at Northern Kentucky University (NKU), University of Kentucky (UK), and University of West Georgia (UWG). The survey was administered during the first week of classes and included demographic data and TV/music preferences. We received responses from 995 students - 186 from NKU, 284 from UK, and 525 from UWG. Response rates were 68.89%, 54.62%, and 38.60%, respectively. Specifically, we asked students to rank their top 5 favorite TV shows and top 3 favorite musicians. It is possible that preferences are regional and may not be (inter)nationally generalizable. As such, we recommend that instructors conduct their own brief survey at the beginning of the semester to ensure appropriate selection of resources during the course.

Table 1
SUMMARY STATISTICS

	Obs	Mean	Std. Dev.	Min.	Max.
Age	924	21.482	4.127	15	58
Gender					
Male	978	0.506	0.500	0	1
Female	978	0.493	0.500	0	1
Other	978	0.001	0.032	0	1
Race/Ethnicity					
White	943	0.733	0.443	0	1
Hispanic	943	0.083	0.276	0	1
African-American	943	0.120	0.325	0	1
Asian	943	0.043	0.204	0	1
Other	943	0.021	0.144	0	1
Class Standing					
Freshman	973	0.303	0.460	0	1

Sophomore	973	0.368	0.482	0	1
Junior	973	0.247	0.431	0	1
Senior	973	0.082	0.275	0	1

RESULTS

Table 1 provides summary statistics for the sample. The average age in our sample was 21.5 years old, of which 50% of them are male. The sample is mostly white (73%); African-Americans are the second largest group representing 12% of the sample. Our study was administered to Principles-level courses at NKU and UK, while UWG surveyed all Economics courses. The majority of the students (37%) are sophomores, followed by 30% freshmen, 25% juniors, and 8% seniors.

Our goal it to better understand the popular media our students consume in an effort to provide more relevant examples. Since economics educators have created resources with the intent to engage students it is imperative to validate whether the resources available match students' consumption and stated preferences.

Table 2
TV SHOWS AND FAVORITE MUSICIANS - STUDENT PREFERENCES

Ranking	TV Show (Freq.)	Musician/Artist (Freq.)
1	Grey's Anatomy (109)	Drake (102)
2	The Office (102)	Taylor Swift (54)
3	Friends (101)	J. Cole (49)
4	Family Guy (75)	Future (49)
5	SportsCenter (71)	Luke Bryan (42)
6	The Walking Dead (70)	21 Pilots (39)
7	How I Met Your Mother (68)	Justin Bieber (39)
8	Parks and Recreation (67)	Adele (37)
9	The Big Bang Theory (56)	Beyoncé (30)
10	Game of Thrones (56)	Ed Sheerhan (23)

Note: Each respondent could list their top 5 choices for TV and top 3 choices for music; the frequencies represent the sum of those choices.

We asked students to list their favorite television shows. These are summarized in Table 2. We found that the most frequently listed show is *Grey's Anatomy*, followed by *The Office* and, the popular 1990's-era show, *Friends*. Economics educators looking to incorporate media in the classroom can create a resource based on Grey's Anatomy or they can utilize work by Kuester, et al. (2014) on The Economics of the Office. Less popular but also with an economic resource available, *The Big Bang Theory* and *Parks and Recreation* are also in the top 10 list. Tierney et al. (2016) provide a website with clips to help connect economic content using popular media to the *The Big Bang Theory*, while Clark and Conaway (2015) have a paper on using *Parks and Recreation*.

When we divide the sample by gender (see tables 3a and 3b) we find that, out of the economics resources available, *The Office* is the only show that appears in both top 10 lists,

while *ESPN* and *SportsCenter* are only in the top 10 list for males. The only popular media resource focused on sports that we are aware of is that by Al-Bahrani and Patel (2015) that uses *ESPN* documentaries to teach economics. Although these documentaries cover a wide range of topics outside of sports, it might require more introduction to interest non-*ESPN* viewers.

Table 3a
FAVORITE TV SHOWS (BY GENDER)

Ranking	Male	Female
1	SportsCenter (71)	Grey's Anatomy (106)
2	Family Guy (61)	Friends (71)
3	The Office (59)	The Bachelor (46)
4	The Walking Dead (50)	The Office (43)
5	Breaking Bad (47)	New Girl (41)
6	ESPN (43)	Scandal (39)
7	Game of Thrones (41)	Criminal Minds (39)
8	South Park (39)	Pretty Little Liars (34)
9	How I Met Your Mother (38)	American Horror Story (33)
10	Parks and Recreation (37)	How I Met Your Mother (31)

Note: Each respondent could list their top 5 choices for TV; the frequencies represent the sum of those choices.

Table 3b
FAVORITE MUSICIANS (BY GENDER)

Ranking	Male	Female
1	Drake (62)	Taylor Swift (47)
2	Future (37)	Drake (40)
3	J. Cole (35)	Justin Bieber (35)
4	Eminem (21)	Adele (32)
5	Wiz Khalifa (20)	Beyoncé (30)
6	Kendrick Lamar (17)	Luke Bryan (29)
7	Kanye West (17)	21 Pilots (26)
8	21 Pilots (13)	Carrie Underwood (17)
9	Kenny Chesney (13)	Ed Sheeran (15)
10	Luke Bryan (13)	Maroon 5 (15)

Note: Each respondent could list their top 3 choices for music; the frequencies represent the sum of those choices.

One concern about our data is the lack of information on the medium students use to view these popular media. Other than the devices (smartphones, TV, laptops, etc.), students have a wide array of choices when it comes to accessing their favorite TV shows/music. These include whether students choose to have cable, Netflix, Hulu, HBO Go, etc., or whether they access TV shows using the log-in information of family/friends. The more narrow the students' choices, the more it directs them to certain media. What they watch could be affected by their prior decision device, subscription service, etc. Another concern is whether the data can be generalized to the

rest of the student population. Though we include the preferences of students from three different types of institutions, the data may still be biased based on the type of student that chooses to go to a particular type of school.

CONCLUSION

The use of popular media by faculty to relate economics concepts to students is growing, as evidenced by many recent papers on the topic. Researchers are decoding shows/movies/music that seems to be trending with the general population in an effort to use them in the classroom. However, these shows may not be students' favorites. We conduct a survey of student perceptions at three institutions to gauge the current popularity of TV shows and musicians. In summary, though there is some overlap between the resources currently available and student preferences, there appears to be a great divide between what faculty and students think in terms of TV/music popularity, at least when considering the resources faculty have invested time to develop. This has implications for pedagogical efficiency. The easiest choice of media for the faculty member to use as an example in class may not be the optimal choice to engage the student and enhance their learning experience. Researchers in this area should continue to update the number and type of TV/music resources that are available. In addition, careful studies of the efficacy of such methods are warranted.

REFERENCES

Acchiardo CJ, A Al-Bahrani, D Patel, BJ Sheridan (2015) Dive in! Tips for teaching economics through Shark Tank (Working Paper). Retrieved from SSRN: http://ssrn.com/abstract=2655655

Al-Bahrani A and D Patel (2015) Using ESPN 30 for 30 to teach Economics. *Southern Economic Journal,* 81(3), 829-842.

Becker WE and M Watts (1996) Chalk and talk: A national survey on teaching undergraduate Economics. *The American Economic Review,* 86(2), 448-453.

Clark C and B Conaway (2015) Swansonomics: Using Parks and Recreation to teach Economics. *The Journal of Economics and Finance Education,* 14(1), 41-68.

Duncan D, S Muchiri & M Paraschiv (2016) The economics of Breaking Bad: A guide to Microeconomic Principles. *Working Paper.*

Ghent LSA Grant & G Lesica (2011) The economics of Seinfeld. *The Journal of Economic Education,* 42(3), 317-318.

Gillis MT and J Hall (2010) Using the Simpsons to improve economic instruction through policy analysis. *The American Economist,* 55(1), 84-92.

Hall J and RA Lawson (2008) Using music to teach Microeconomics. *Perspectives in Economic Education Research,* 4(1), 23-36.

Hall J, R Lawson & GD Mateer (2008) From ABBA to Zeppelin, Led: Using music to teach Economics. *Journal of Economic Education,* 39(1), 107.

Hoyt GM (2003) How to make Economics the fulfilling social science. *Southern Economic Journal,* 70(1), 201-206.

Harter C (2003) Murder versus music: Giving students a choice in Introductory Economics. *Journal for Music Economics Educators,* 3(4),1-20.

Holder K, A Hoffer, A Al-Bahrani & S Lindahl (2015) Rockonomix. *The Journal of Economic Education,* 46(4), 443.

Kuester DD, GD Mateer & CJ Youderian (2014) The economics of The Office. *The Journal of Economic Education,* 45(4), 392.

Luccasen RA and MK Thomas (2010) Simpsonomics: Teaching economics using episodes of The Simpsons. *The Journal of Economic Education,* 41(2), 136-149.

Leet D and S Houser (2003) Economics goes to Hollywood: Using classic films to create an undergraduate Economics course. *Journal of Economic Education,* 34(4), 326-332.

Mateer GD and A Rice (2007) Using music synchronized with lyrics to teach Economics. *Perspectives on Economic Education Research,* 3(1), 53-64.

Mateer GD and EF Stephenson (2011) Using film clips to teach Public Choice Economics. *Journal of Economics and Finance Education,* 10(1),28-36.

Mateer GD, LS Ghent & M Stone (2011) TV for Economics.*The Journal of Economic Education*, 42(2), 207.

Mateer GD and H Li (2008) Movie scenes for Economics. *The Journal of Economic Education,* 39(3), 303.

McClough D and J Heinfeldt (2012) Assessing the effectiveness of music lyrics in conveying economic concepts. *Journal of Economics and Economic Education Research*, 13(2), 55.

Miller JD and RP Rebelein (2012) Research on the effectiveness of non-traditional pedagogies. In G.M. Hoyt and K McGoldrick (eds.), *International Handbook on Teaching and Learning Economics* (pp. 323-333). Edward Elgar.

Sanburn J (2015) Here's what MTV is calling the generation after millennials. *Time*. Retrieved December 1, 2015, from http://time.com/4130679/millennials-mtv-generation/?xid=newsletter-brief

Santos J and AM Lavin (2004) Do as I do, not as I say: Assessing outcomes when students think like economists. *The Journal of Economic Education*, *35*(2), 148-161.

Sexton RL (2006) Using short movie and television clips in the economics principles class. *The Journal ofEconomic Education,* 37(4), 406-417.

Sheridan BJ, GM Hoyt & J Imazeki (2014) A primer for new teachers of economics. *Southern Economic Journal*, 80(3), 839-854.

Tinari FD and K Khandke (2000) From rhythm and blues to Broadway: Using music to teach economics. *Journal of Economic Education,* 31(3), 253-270.

Tierney JE, GD Mateer, W Geerling, JJ Wooten & BO Smith (2016) Bazinganomics: Economics of The Big Bang Theory. *The Journal of Economic Education,* 47(2), 192.

Watts M and G Schaur (2011) Teaching and assessment methods in undergraduate economics: A fourth quinquennial survey. *The Journal of Economic Education,* 42(3), 294-309.

THE EFFECT OF TEACHER QUALITY ON THE CHARTER VERSUS PUBLIC SCHOOL DECISION

Lauren Calimeris, St. John Fisher College

ABSTRACT

This paper combines restricted-use data from the 2007-2008 SASS and a disaggregated measure of teacher quality based on undergraduate institutional competitiveness to determine where higher quality teachers teach. Higher quality teachers are more likely to teach at charter schools versus public schools than are lower quality teachers. This effect generally increases with college-based competitiveness. The effect is largest among the youngest cohort of teachers; those who are of the highest quality, those graduating from the highest ranked colleges, are 11 percentage points more likely to choose a charter school than their lower quality counterparts. These findings suggest that traditional public schools may be at a disadvantage in attracting teachers who graduate from the best colleges and universities.

Keywords: *Teacher quality; Teacher sorting; Charter schools; School choice; Resource allocation. JEL Codes: I21; J20; J45*

INTRODUCTION

The quality of public education in the United States is of major concern to policy makers, voters, and the general public. Over the past few decades, many programs and policies have been implemented to address some of the pitfalls in education. Some of these programs include school choice options, including charter schools, while others include increasing teacher qualification requirements.

Between their inception in 1992 and 2010, charter schools grew to operate over 5,000 schools in 39 states and the District of Columbia (Center for Education Reform, 2010). Charters are a free alternative choice for parents. They are publicly funded and have more autonomy and greater accountability than traditional public schools (henceforth, public or traditional schools). Charters may have different academic focuses or may target different student populations.

Opponents to the charter school movement believe that charters may drain resources from traditional schools (Dillon, 2010). Teachers are a key input into the education production function (see for example, Aaronson, Barrow, & Sander, 2002; Ferguson, 1991; Ferguson & Ladd, 1996; Goldhaber, 2002; Hanushek & Rivkin, 2003; Hanushek, 1971; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004), with teacher quality associated with 7% of the variance in student achievement gains (Rivkin et al., 2005). One way to address if charters drain resources is to investigate if higher quality teachers are more abundant at charter or public schools. Also, teachers may have faced different choice sets depending upon when they graduated from college, before or after the introduction of charter schools in the early- to mid-1990s. Depending upon when a teacher graduated from college, there may be a difference in the probability of teaching at a charter versus public school for different quality teachers.

This paper's main contribution is the investigation of sorting decisions among different

quality teachers and different cohorts of teachers using data from the 2007-2008 Schools and Staffing Survey (SASS). This paper also makes two secondary methodological contributions. When the data do not allow for value-added measures of teacher quality, researchers must proxy for teacher quality using other variables. This paper demonstrates that when proxying for teacher quality using the teacher's undergraduate college's competitiveness, the competitiveness should be measured at the time of enrollment as college competitiveness is not constant over time. In addition, teacher quality should be proxied for as precisely as possible because aggregate classifications obscure distinctions in the choices made by teachers of different underlying quality.

This paper is organized as follows: Section 2 provides the background of the teacher quality proxy, and section 3 analyzes college competitiveness. Section 4 discusses teacher quality. Section 5 details perceived and real differences in charter and public schools. Section 6 explains the estimation strategy. Section 7 discusses the study findings. Section 8 concludes.

TEACHER QUALITY BACKGROUND

Measuring teacher quality is extremely difficult. Most characteristics of effective teachers such as passion, enthusiasm, work ethic, and people skills, are not easily measurable. Even so, studies have tried to find quantitative and observable ways of measuring quality. Studies that are able to link teachers directly to their students' outcomes implement a value-added measurement of teacher quality. When this linkage is unavailable, other proxies for quality are implemented. Licensure, testing, certification, and advanced degrees are considered observable measures of quality but are not consistently associated with improvements in student outcomes or teacher quality (Angrist & Guryan, 2008; Angrist & Guryan, 2004; Berliner, 2005).

On the other hand, studies have found that a teacher's innate ability and intelligence are associated with positive gains in student outcomes. They have established measures of intelligence, including the teacher's SAT/ACT scores or college competitiveness as good indicators of effectiveness (Angrist & Guryan, 2004; Coleman, Campbell, Hobson, McPartland, Mood, & Weinfeld, 1966; Ehrenberg & Brewer, 1994). The competitiveness of a teacher's college is also a common proxy for measuring teacher quality (Bacolod, 2007a; Ballou, 1996; Ballou & Podgursky, 1997; Ballou & Podgursky, 1995; Baker & Dickerson, 2006; Boyd, Lankford, Loeb, Ronfeldt, & Wyckoff, 2010; Boyd, Lankford, Loeb, & Wyckoff, 2003; Carruthers, 2009; Clotfelter, Ladd, & Vidgor, 2006; Ehrenberg & Brewer, 1994; Figlio, 1997; Podgursky, Monroe, & Watson, 2004)[1]. The majority of these studies utilize the rankings from *Barron's Profiles of American Colleges*, which categorizes undergraduate institutions into one of 6 tiers: Most Competitive, Highly Competitive, Very Competitive, Competitive, Less Competitive, and Non Competitive. Other studies use similar rankings, such as the UCLA Higher Education Research Institute's ranking (Bacolod, 1997a) or a measure by Lovejoy (Figlio, 1997).

Most studies implementing college competitiveness as a proxy for teacher quality create aggregates of the original Barron's categories, though the aggregations are not consistent. Baker and Dickerson (2006) and Lankford, Loeb, and Wyckoff (2002) consider teacher quality to be dichotomous, aggregating the top two tiers together and all other ranks together. Carruthers (2009) also treats quality to be dichotomous, though she aggregates all teachers graduating from the top four tiers together. Meanwhile, Clotfelter et al. (2006) create three aggregations: teachers from the top three tiers form the top group, those from competitive colleges are the middle group, and those from the lowest two tiers comprise the final group. Ehrenberg and Brewer (1994), who provide the evidence that increases in teacher quality as measured by the Barron's ranking do significantly improve students' outcomes do not aggregate ranks, nor does Hoxby (2002)

While aggregating quality categories is common, most studies do not explain why they do it. Some studies aggregate because their samples, especially among the higher ranks, are small (Podgursky et al., 2004), as individuals who attend more competitive colleges or who have higher standardized test scores are less likely to be teachers (Ballou, 1996; Hanushek & Pace, 1995). Studies do not address if aggregations are masking effects of finer quality levels on their outcomes.

COLLEGE RANKINGS

Most studies proxying for quality with college rankings use a single year, or a reference year, of rankings. Most do not choose the reference year corresponding to when their teachers attended college. Few even mention their reference year. Of those that do, some studies choose a year that is the closest to when their median teachers attended (Hoxby, 2002) or entered (Carruthers, 2009) college. The reference year chosen could affect results if competitiveness changes over time, as teachers could be assigned an incorrect quality measure, something most studies ignore. If competitiveness changes, measurement error would lead to attenuation bias in study results.

This study uses the college rankings from *Barron's Profiles of American Colleges*, which ranks all four year institutions which offer bachelor's degrees if they are fully accredited or are recognized as candidates for accreditation. Ranks are based on incoming freshmen characteristics, such as high school class rank, SAT/ACT scores, GPA, and acceptance rate, from the academic year prior to the publication year. For example, the 1996 rankings are based on the characteristics of the entering freshmen of the 1995-1996 academic year. The first year of publication was 1964, and the Profiles are revised biennially.

This study compiled a dataset of rankings for the publication years 1970, 1984, 1986, 1992, 1994, 1996, 1998, 2000, and 2002. These years correspond to when the teachers of most interest in the SASS entered college. Charter schools first opened in 1992, with the bulk of states passing charter laws between 1993-1998[2]. Teachers graduating after 1992 will have had the charter option in their choice set at the onset of employment. Accordingly, the ranking dataset consists of rankings since the inception of charters along with a subset of previous rankings. Earlier rankings allow competitiveness to be tracked over time to determine if it changes. More earlier years were not included as established teachers will have little incentive to leave their schools, while newer teachers have more perceived flexibility and are of the most interest to this study.

This study identified the Barron's ranked colleges IPEDS codes from the National Center of Education Statistics (NCES) for use in merging the rankings to the SASS data. It dropped specialized colleges (e.g., religious or arts schools), those that closed or merged, colleges with multiple campuses that are not uniquely identifiable in both datasets, and foreign colleges from the analysis.

Simple correlations of the rankings illustrate that rankings do shift. The correlation in ranks from 1970 and 2002 is 0.64. Among the highest two ranks (as of 2002), the correlation is 0.55. Thus, there is movement in the rankings for all levels of colleges, and it is greater among the best.

Table 1 illustrates how the ranks change from 1970 to 2002. Most changes are increases[3]. Among all universities, nearly 37% have increased in ranking between 1970 and 2002, while 19% have decreased. Roughly 44% did not change over time.

Table 1
Frequencies of Differences in University Ranks from 1970 to 2002

	All Universities		Very, Highly, or Most Competitive in 2002		Highly or Most Competitive in 2002		Very, Highly, or Most Competitive in 1970		Highly or Most Competitive in 1970	
	N	%	N	%	N	%	N	%	N	%
3 Categories Lower 2002	2	0.2	0	0.0	0	0.0	2	0.9	2	2.2
2 Categories Lower 2002	25	2.2	0	0.0	0	0.0	9	3.9	1	1.1
1 Category Lower 2002	198	17.0	14	3.7	5	3.3	46	19.7	14	15.4
No Difference	512	44.0	99	26.4	39	25.3	99	42.3	39	42.9
1 Category Higher	337	29.0	188	50.1	66	42.9	66	28.2	35	38.5
2 Categories Higher 2002	86	7.4	71	18.9	41	26.6	12	5.1	0	0.0
3 Categories Higher 2002	3	0.3	3	0.8	3	2.0	0	0.0	0	0.0
Total	1,163	100	375	100	154	100	234	100	91	100

Among universities ranked in the top three tiers in 2002, 70% have increased in rank since 1970 while roughly four percent decreased. Among the top two ranks, 70% increased compared to three percent that decreased. Increases are not surprising for schools achieving ranks in the top categories in 2002, but the number of tiers jumped indicates that at least 44 universities in the top two tiers in 2002 were not in this group in 1970. These universities, and thus their earlier graduates, may be incorrectly classified both using a reference year and in aggregated groupings due to their large movements.

Columns 7 and 8 in Table 1 illustrate movement among to the top universities in 1970. Among the top three tiers, 33% of universities increased in rank while 24% decreased, and 42% remained the same. For the top two tiers, nearly 39% increased, and roughly 19% decreased. The findings suggest that some top ranked universities may have jumped aggregated groupings.

Table 1 demonstrates that college rankings are dynamic. Using a reference year may lead to erroneous inferences and measurement error. Furthermore, the number of tiers that colleges may change over time suggests that aggregating the quality measures will not solve the misclassification problem. These findings support the idea of tracing college rank back to when the teacher entered college.

TEACHER QUALITY

The SASS is administered every four years and is a stratified probability proportional to size sample of school teachers across the United States designed to be representative of the nation. It is composed of a series of questionnaires, including school and teacher questionnaires. The teacher survey contains information on teacher demographics (e.g., age, race, sex) and education, including the name of teachers' undergraduate institutions and IPEDS codes, majors, degrees obtained, and graduation years. It does not allow for teachers to be linked directly to their students' outcomes; therefore, using a fixed-effects or value-added method to measure teacher quality is not possible given the data. Therefore, this study must proxy for teacher quality by using the competitiveness of the teacher's undergraduate institution.

The IPEDS code matches the SASS teachers and the college rank dataset. Teacher "matched ranking" is the Barron's ranking of the teacher's college published in the year of or the

year subsequent to his enrollment. For example, a teacher who entered college in 1983 or in 1984 received the 1984 rank, while one who entered college in 1985 or in 1986 received the 1986 ranking. The matched rankings represent the college-based teacher quality measure. This paper excluded teachers who entered college in a year whose ranks were not included in the ranking dataset[4].

In the 2007-2008 SASS, 18,100[5] teachers match with their institution's ranking when the teacher entered college. Of these, 17,290 were full or part time regular teachers[6]. Only the 14,030 teachers who attended college in a state with charter laws as of 2007 are included in the primary analysis. Since teachers prefer to teach close to where they grew up or to where they went to college (Boyd, Lankford, Loeb, & Wyckoff, 2005; Boyd et al., 2003), this paper assumes teachers who were educated in non-charter states do not perceive themselves to face the same choice as teachers who were not . It assumes that the cost of finding a charter job is different for these teachers than for those educated in charter states[7].

To highlight the importance of the matched ranking measure, this study also uses a reference year teacher quality measure to illustrate differences between the two measures. The 2002 ranks are the reference year ranking. This year was chosen as it corresponds to when the most recent graduates enrolled in college (e.g., teachers who graduated from college in 2006 entered in 2002, and those who graduated in 2007 entered in 2003), allowing for the largest matched sample of teachers post charter introduction.

Table 2 presents the frequencies of college rankings in different subgroups of teachers, using both the matched ranking and the 2002 ranking. It illustrates how the two methods of assigning ranks result in different distributions of college-based teacher quality. The differences grow as the reference year is further from the true entrance year. Table 2 also shows how the frequencies differ between public and charter teachers.

Table 2
Frequencies of College Competitiveness among Teachers in Matched Sample

	Teachers Entering College before 1980							
	Matched Ranking				2002 Ranking			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
Non Competitive	0	0.0	40	3.3	0	0.0	30	2.5
Less Competitive	10	50.0	370	30.6	10	50.0	250	20.7
Competitive	10	50.0	640	52.9	10	50.0	590	48.8
Very Competitive	0	0.0	130	10.7	0	0.0	220	18.2
Highly Competitive	0	0.0	30	2.5	0	0.0	100	8.3
Most Competitive	0	0.0	10	0.8	0	0.0	30	2.5
Total	20	100	1,210	100	20	100	1,210	100
	Teachers Entering College between 1980-1989							
	Matched Ranking				2002 Ranking			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
Non Competitive	10	16.7	250	11.3	0	0.0	110	5.0
Less Competitive	10	16.7	550	24.9	10	16.7	450	20.4
Competitive	30	50.0	1050	47.5	30	50.0	1070	48.4
Very Competitive	10	16.7	280	12.7	20	33.3	410	18.6
Highly Competitive	0	0.0	60	2.7	0	0.0	120	5.4
Most Competitive	0	0.0	20	0.9	0	0.0	50	2.3
Total	60	100	2,210	100	60	100	2,210	100
	Teachers Entering College between 1990-1999							
	Matched Ranking				2002 Ranking			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
Non Competitive	30	7.69	640	8.7	20	5.1	400	5.4
Less Competitive	70	17.9	1320	17.9	70	17.9	1390	18.8
Competitive	160	41.0	3730	50.5	170	43.6	3690	49.9
Very Competitive	90	23.1	1220	16.5	90	23.1	1360	18.4
Highly Competitive	30	7.7	410	5.5	30	7.7	410	5.5
Most Competitive	10	2.6	80	1.1	20	5.1	140	1.9
Total	390	100	7,390	100	390	100	7,390	100
	Teachers Entering College between 2000-2002							
	Matched Ranking				2002 Ranking			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
Non Competitive	10	5.9	170	6.6	10	5.9	140	5.4
Less Competitive	20	11.8	480	18.7	20	11.8	460	17.9
Competitive	80	47.1	1260	49.0	80	47.1	1320	51.4
Very Competitive	40	23.5	470	18.3	40	23.5	450	17.5
Highly Competitive	10	5.9	150	5.8	10	5.9	150	5.8
Most Competitive	10	5.9	40	1.6	10	5.9	40	1.6
Total	170	100	2,570	100	170	100	2,570	100

Note: Teachers are regular full- or part-time teachers educated in charter states only. Sample sizes rounded to nearest 10 for confidentiality purposes. Samples may not add up due to rounding.

The 2002 ranks overstate the number of teachers from better colleges for both public and charter teachers. This is expected, given the upward trend in ranks over time. The discrepancies are even more pronounced as the teacher's actual college entrance year is further from the reference year. Among teachers who entered college prior to 1980, the matched ranking measure finds 0.8% of traditional teachers hail from Most Competitive colleges and 2.5% from Highly Competitive colleges. The 2002 measure classifies 2.5% of these same teachers from Most Competitive and 8.3% from Highly Competitive colleges. The matched ranking finds roughly 11% of teachers are from Very Competitive colleges compared to 18% using the 2002 ranking.

For charter teachers entering college between 1980-1989, the matched ranking indicates that none are in the top two tiers, while the 2002 ranking indicates there are a few, though the small number rounds to zero. For traditional teachers, the matched ranking classifies 3.6% in the top two, compared to 7.7% using the 2002 ranking. The discrepancies illustrate that volatility in competitiveness is translated to the teacher population. The reference year rankings are distorting, and results based on this measure are likely to be biased.

Table 2 also illuminates how few teachers are from the top colleges, which is consistent with Hoxby's 2002 findings. The matched ranking indicates 6.1% of all teachers are in the top two tiers. For teachers entering college before 1980, no charter teachers hail from Most Competitive colleges while 10 (0.8%) traditional teachers do. For those entering in the 1980s, none of the 60 charter teachers are in the top two tiers, while 80 of the 2,210 traditional teachers are. The percentage of teachers in these ranks is increasing over time for both groups.

Table 3 expands on Table 2 by illustrating how many categories a teacher's college rank differs between the two assignment methods for different subgroups. While roughly 61% of all teachers are ranked the same, nearly 25% of public teachers are ranked higher using the 2002 ranking than the matched ranking. Roughly 17% are ranked lower in 2002. Among charter teachers, 22% are ranked higher, and 13% are ranked lower.

Table 3 also reiterates how using a reference year is more distorting the further away it is from the actual entrance year. For those who entered college after 1999, 94% of charter and 89% of public teachers are ranked the same between the two methods. For those entering in the 1990s, only 59% and 57% of charter and public teachers are. The percentages drop to 50% and 48% for charter and public teachers entering in the 1980s. For those entering before 1980, 50% of charter teachers have the same ranking while 46% of public teachers do.

The evidence presented illustrates that college ranks change over time, and these changes are reflected in the teacher population. There is a difference in rankings between public and charter school teachers, and this difference appears greater the older the teacher. Older teachers from better colleges are traditional school teachers, while there is a greater percentage of Most and Highly Competitive alumni in charters versus traditional schools among the younger teachers. Since teacher quality is based on college competitiveness, teacher quality distributions differ depending upon how the rankings are assigned to the teacher. The greater the difference in the reference year and when the teacher actually entered college, the greater the misrepresentation. Furthermore, the misrepresentation differs for charter and traditional public school teachers.

These results suggest that teacher quality should be measured by the rank of their undergraduate college at the time of their enrollment in order to avoid the mismeasurement biases which might arise if ranks are assigned from a single reference year. The analysis below pursues this suggestion and quantifies the extent of these biases.

Table 3
Frequencies of Differences in Rankings between the Matched Rankings & 2002 Rankings

	2000s College Entrants				1990-1999 College Entrants			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
3 Categories Lower in 2002	0	0.0	0	0.0	0	0.0	0	0.0
2 Categories Lower in 2002	0	0.0	0	0.0	0	0.0	100	1.4
1 Category Lower in 2002	0	0.0	120	4.7	70	17.9	1240	16.8
No Difference	160	94.1	2280	88.7	230	59.0	4240	57.4
1 Category Higher in 2002	10	5.9	150	5.8	80	20.5	1500	20.3
2 Categories Higher in 2002	0	0.0	20[a]	0.8	10	2.6	280	3.8
3 Categories Higher in 2002	0	0.0	0	0.0	0	0.0	30	0.4
Total	170	100	2,570	100	390	100	7,390	100

	1980-1989 College Entrants				pre-1980 College Entrants			
	Charter		Traditional		Charter		Traditional	
	N	%	N	%	N	%	N	%
3 Categories Lower in 2002	0	0.0	0	0.0	0	0.0	0	0.0
2 Categories Lower in 2002	0	0.0	20	0.9	0	0.0	20	1.7
1 Category Lower in 2002	10	16.7	300	13.6	0	0.0	170	14.0
No Difference	30	50.0	1050	47.5	10	50.0	550	45.5
1 Category Higher in 2002	20	33.3	670	30.3	10	50.0	350	28.9
2 Categories Higher in 2002	10	16.7	170	7.7	0	0.0	130	10.7
3 Categories Higher in 2002	0	0.0	10	0.5	0	0.0	10	0.8
Total	60	100	2,210	100	20	100	1,210	100

Note: Sample sizes rounded to nearest 10 for confidentiality purposes. Columns may not add up due to rounding.
[a] Estimate refers to 2 or 3 categories higher in 2002

TEACHER PERCEPTIONS OF CHARTER & PUBLIC SCHOOLS

Proponents of charter schools claim that teachers choose charters because they can avoid the bureaucracy associated with traditional schools. Charters are also attractive as they focus on student needs and outcomes (Center for Education Reform, 2010). Dye and Antle (1984) suggest that if productivity is correlated with preferences for nonpecuniary job aspects, then different types of workers might systematically sort across jobs, even in the absence of a monetary productivity premium. Accordingly, different quality teachers may be attracted to different school types due to associated nonpecuniary attributes. For charters, these attributes may include a shorter schedule, fewer hours, or more autonomy in the classroom. Teachers sort and workplace characteristics matter, with higher quality teachers less likely to teach at urban (Ehrenberg & Brewer, 1994; Figlio, 2002; Figlio, 1997) or poorer schools (Bacolod, 2007b, Lankford et al., 2002). Charter or public school bundles also may enter into preferences.

The SASS contains questions on school characteristics, teacher pay, and teachers' perspectives of their school. The mean values of the responses for charter and public teachers are presented in Tables 4 and 6. The tables also indicate if the differences in the responses are

significant.

Table 4
Differences between Charter and Public School Teachers Workplace Characteristics

	Charter Mean	n	Public Mean	n	Difference	t-stat	N
School Characteristics							
Contract Days	199	640	189	13390	10	8.92	14030
Hours per Week Required	39.1	640	37.9	13390	1.2	6.39	14030
Hours of Teaching per Week Required	30.6	640	29.6	13390	1.0	4.25	14030
Union Status (=1)	0.26	640	0.71	13390	-0.45	-24.68	14030
Pay Base	$38,379	640	$42,913	13390	-$4,534	-9.43	14030
Annual Earnings	$39,989	640	$45,235	13390	-$5,246	-10.32	14030

Note: Sample sizes rounded to nearest 10 for confidentiality purposes.

Table 4 details summary statistics on basic workplace characteristics. On average, charter teachers report having longer contracts than public school teachers. They have more required hours and teaching hours per week. Charter teachers are significantly less likely to be in a union. They also earn significantly less money, on average, than traditional teachers. Since pay can vary with experience, teacher reported average pay by tenure is presented in Table 5.

The top half of Table 5 reports base pay and actual earnings by total experience. Charter teachers' average base pay is significantly lower than public teachers' for all except for those with 1-3, 10-14, 20-24, or over 30 years of experience. Average total earnings are significantly less for charter teachers, though the significance varies for those with over 20 years of experience.

The bottom half of Table 5 reports base pay and annual earnings based on tenure at the teachers' current schools. For their first 9 years of experience, charter teachers' base pay is significantly lower than public school teachers' base pay. For teachers with 10 or more years of tenure at a school, the significance disappears. For the most tenured, charter teachers report slightly higher pay, though the difference is insignificant. The trends are similar for total earnings.

If charter schools are to attract higher quality teachers despite lower salaries and longer school days and years, then other aspects of charter school employment must be more attractive than in traditional schools. The SASS contains questions regarding how much control teachers believe they have on certain aspects of their teaching. Answers range from 1-4, with a value of 1 corresponding to “No control” and 4 corresponding to “A great deal of control.” Table 6 presents the mean responses for charter and public school teachers and indicates if any differences are significant.

The top portion of Table 6 suggests that on average, charter teachers rate their control over selecting instructional materials and course content higher than public school teachers. They rate their control over determining the amount of homework lower than their public school counterparts.

The SASS also contains questions regarding teacher perceptions. Answers range from 1-4, with a value of 1 corresponding to “Strongly disagree” and 4 corresponding to “Strongly agree.”[8] In the bottom of Table 6, a positive (negative) difference means the charter teachers agree (disagree) more with the statement than public school teachers.

Responses indicate that while charter teachers are less satisfied with their salaries than public teachers, they are not more likely to leave for greater pay. They are less satisfied with teaching at the school and less likely to believe their peers are happy. They worry more about job security due to student performance. They believe more that the school is not run well, and they report lower satisfaction with the adequacy of teaching materials and support for disabled students

than public teachers.

Table 5
Differences between Charter and Public School Base & Total Pay

	Charter Mean	n	Public Mean	n	Difference	t-stat	N
			Base Pay				
Years of Experience							
1-3 years	$36,009	270	$36,228	3520	-$220	-0.45	3790
4-5 years	$37,105	140	$39,178	2020	-$2,073	-2.80	2150
6-9 years	$40,284	150	$42,662	3360	-$2,379	-2.85	3510
10-14 years	$43,814	50	$46,263	2060	-$2,449	-1.37	2110
15-19 years	$42,449	20	$51,542	1190	-$9,093	-3.18	1220
20-24 years	$44,976	10	$52,652	450	-$7,677	-1.55	460
25-30 years	$38,768	10	$53,835	180	-$15,067	-2.17	190
30 plus years	$55,784	10	$56,668	610	-$884	-0.17	620
All	$38,379	640	$42,913	13390	-$4,534	-9.43	14030
			Total Earnings				
1-3 years	$37,412	270	$38,276	3520	-$864	-1.65	3790
4-5 years	$38,829	140	$41,570	2020	-$2,741	-3.30	2150
6-9 years	$41,984	150	$45,036	3360	-$3,052	-3.36	3510
10-14 years	$45,413	50	$48,853	2063	-$3,441	-1.84	2110
15-19 years	$44,969	20	$53,926	1190	-$8,956	-2.98	1220
20-24 years	$47,084	10	$54,888	450	-$7,804	-1.52	460
25-30 years	$41,208	10	$56,307	180	-$15,099	-2.05	190
30 plus years	$57,192	10	$59,057	610	-$1,864	-0.34	620
All	$39,989	640	$45,235	13390	-$5,246	-10.32	14030
Years at Current School			**Base Pay**				
1-3 years	$37,304	450	$39,072	6340	-$1,768	-3.75	6790
4-5 years	$37,965	100	$41,842	2110	-$3,876	-3.85	2220
6-9 years	$42,062	70	$45,437	2590	-$3,376	-2.40	2660
10-14 years	$48,472	10	$48,898	1190	-$427	-0.11	1210
15-19 years	$59,030	0	$52,573	600	$6,457	0.79	610
			Total Earnings				
1-3 years	$38,734	450	$41,214	6340	-$2,480	-4.95	6790
4-5 years	$40,065	100	$44,278	2110	-$4,214	-3.86	2220
6-9 years	$43,913	70	$47,938	2590	-$4,025	-2.68	2660
10-14 years	$50,288	10	$51,475	1190	-$1,187	-0.30	1210
15-19 years	$64,662	0	$54,864	600	$9,798	1.15	610

Note: Sample sizes rounded to nearest 10 for confidentiality purposes. Columns and rows may not add up due to rounding.

Compared to public school teachers, charter teachers believe that their peers are more

likely to enforce school rules. They agree more that their principals communicate goals and that the staff is more cooperative. Charter teachers report that other duties and paperwork interfere less with their teaching than traditional teachers. Finally, they report having maintained enthusiasm at a greater rate.

Table 6
Differences between Charter and Public School Teachers' Beliefs about Workplace Characteristics

	Charter Mean	n	Public Mean	n	Difference	t-stat	N
Has Control Over[a]:							
Selecting Instructional Materials	2.90	640	2.75	13390	0.15	3.40	14030
Selecting Course Content	3.00	640	2.80	13390	0.21	4.87	14030
Selecting Teaching Techniques	3.69	640	3.70	13390	-0.01	-0.33	14030
Evaluating and Grading Students	3.63	640	3.62	13390	0.01	0.32	14030
Disciplining Students	3.46	640	3.46	13390	0.01	0.29	14030
Determining Amount of Homework	3.60	640	3.73	13390	-0.13	-5.43	14030
Agreement[b]:							
Satisfied Salary	2.28	640	2.37	13390	-0.09	-2.24	14030
Would Leave for More Pay if Possible	1.97	640	1.95	13390	0.02	0.58	14030
Satisfied with Teaching at School	3.38	640	3.46	13390	-0.09	-3.14	14030
Teachers at School are Happy	2.95	640	3.04	13390	-0.09	-2.73	14030
School is Run Well	2.88	640	3.00	13390	-0.12	-3.60	14030
Not Worth Teaching at Current School	1.78	640	1.75	13390	0.03	0.86	14030
Wants to Transfer to Another School	2.17	640	1.96	13390	0.21	5.13	14030
Worried about Job Security due to Student Test Performance	2.09	640	2.01	13390	0.08	2.12	14030
Administration Supportive	3.38	640	3.38	13390	-0.01	-0.16	14030
Parents Supportive	2.64	640	2.61	13390	0.02	0.68	14030
Principal Enforces School Rules & Supports Teachers	3.37	640	3.37	13390	-0.01	-0.24	14030
Teachers Enforce School Rules	2.85	640	2.75	13390	0.10	2.77	14030
Teachers Share Beliefs about School Mission	3.18	640	3.14	13390	0.03	1.16	14030
Principal Communicates School Goals to Teachers	3.43	640	3.37	13390	0.06	1.85	14030
Adequate Support forTeaching Special Needs Students	2.68	640	2.78	13390	-0.09	-2.67	14030
Materials (texts, supplies) Adequate	3.10	640	3.19	13390	-0.09	-2.71	14030
Duties/Paperwork Interfering	2.54	640	2.83	13390	-0.29	-7.80	14030
Staff is Cooperative	3.24	640	3.14	13390	0.10	3.10	14030
Staff Recognized for Good Work	3.03	640	3.00	13390	0.03	0.82	14030
Less Enthusiastic than when Started	2.03	640	2.10	13390	-0.07	-1.72	14030

[a] Teacher reported degree of control (1=No control, 2=Minor control, 3=Moderate control, 4=A great deal of control)
[b] Teacher reported degree of agreement (1=Strongly Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Strongly Agree)
Note: Sample sizes rounded to nearest 10 for confidentiality purposes.

Thus, while charter teachers are paid less, are less satisfied with their schools and more worried about their jobs than public teachers, they are still maintaining their enthusiasm. The support from staff, communication from the principals, and lack of interfering extraneous duties support the suggestion that teachers may be attracted to charters because of nonpecuniary attributes. This paper next investigates whether these preferences are related to quality.

METHODS

While the process through which a teacher and school choose one another is two-sided, the SASS allows only the observation of the result of the matching process. Baker and Dickerson (2006) use 1999-2000 SASS data and assume that the school determines the match. They find charters had a larger share of higher quality teachers than public schools. The estimation equation considers college competitiveness the dependent variable and school type an independent variable. Carruthers (2009) examines North Carolina teachers who switch schools. She finds teachers moving from public to charter schools are less qualified and less likely to have graduated from a competitive college than other movers. She finds that charters do not skim high quality teachers from public schools, though they draw more effective teachers among those switching schools. Like Baker and Dickerson, Carruthers also considers college competitiveness the dependent variable and school type an independent variable.

In both studies, the estimation equation assumes that a future event, the type of school at which a teacher is teaching, predicts a past event, the teacher's undergraduate college competitiveness. They suggest where a teacher currently teaches predicts her college-based teacher quality, when in fact, different quality teachers may self-select into the different school types. These studies reverse the causality of the relationship.

This paper takes a different viewpoint and investigates how teacher characteristics, in particular, teacher quality, influences and predicts the matching result. Assuming a teacher knows her own skill set, a teacher also knows which school would be suitable for her needs and desires in a workplace. Teachers are the ones who decide where to apply and how to sort. A higher quality teacher may like the autonomy at charter schools, while a lower quality teacher may desire more stringent guidelines and the union protection available at public schools. Teachers are the most informed about their own abilities, desires, and beliefs, and ultimately they decide which position to accept, among those offered.

This study assumes that the highest quality teachers can choose their ideal schools[9]. Schools want to hire the best, and there are not enough top quality teachers to fill all positions. Estimates for the highest quality teachers from Most Competitive colleges represent their preferences of school type. The next highest quality teachers, those from Highly Competitive colleges, will also be able to choose their optimal schools, given the position is still available and has not been filled by the highest quality teacher. The interpretation of the coefficient for these teachers represents a mixture of preferences and availability. As quality declines, the interpretation represents availability more than preferences, as lower quality teachers will not be able to choose freely between school types. These teachers will be offered what has not been accepted by the higher quality teachers.

The basic model in this paper is represented by the following equation:

$$Charter_i = \alpha_0 + Q_i'\beta + S_i'\delta + X_i'\gamma + \varepsilon \quad (1)$$

The dependent variable, *Charter*, is an indicator variable equal to one if teacher i teaches at a charter school during the 2007-2008 academic year and is equal to zero if the teacher teaches at a public school. Since the dependent variable is binary, the model is estimated via a probit regression. For each probit, the marginal effects are calculated for a benchmark teacher. The benchmark teacher is a White male of the lowest quality with no graduate degrees, with the average number of years of experience, and who is of the average age for the sample of interest.

The teacher quality proxies are contained in the Q vector. To determine if aggregating could mask effects of finer distinctions of college-based quality, this paper estimates the equation using two specifications of the *Q* vector. The first aggregates college-based quality, creating three groups. Higher Quality is a dummy variable equal to one if teachers hail from Most or Highly Competitive colleges. Lower Quality is a dummy variable equal to one if teachers are from Very Competitive, Competitive, or Less Competitive colleges. Non Competitive teachers comprise the final group. In the second specification, each ranking is included as a binary variable. This specification is of the most interest, as it clearly illustrates what the effects are for differing levels of college-based quality and indicates if there is a stronger effect for those graduating from higher ranked colleges. This paper estimated both specifications using the matched and 2002 rankings to investigate how a reference year might distort findings.

For all specifications, S_i is a vector of educational attainment variables, including if teacher *i* obtained either a Master's degree or a Ph.D.[10]. Finally, X_i is a vector of demographic controls, including teacher *i*'s years of teaching experience, age, gender, and ethnicity [11].

The model is estimated for all teachers pooled together as an introductory exercise. It is then re-estimated for each cohort to determine if sorting differences exist among the different cohorts.

REGRESSION RESULTS

2007-2008 SASS Findings

The results of the probit model for the aggregated quality regression are presented in Table 7. Column 1 presents the estimates using the matched ranking. Column 2 presents the results for the matched population using the 2002 ranking, while Column 3 estimates the equation for all teachers using the 2002 ranking, including those who do not have a matched ranking measure[12].

The estimates affirm the model is plausible as the coefficients all exhibit the expected signs. With respect to controls, the negative and significant coefficient on Master's degree corresponds to the idea that charter teachers have little incentive to obtain an advanced degree compared to public teachers, who are often required by law to get one while the charter teachers are exempt. The table also indicates that more experienced teachers are less likely to work at a charter, holding constant quality. Since charter schools are a relatively recent development, this result is not surprising. A veteran teacher with job security, who has already established her reputation and learned the nuances of her school will have little incentive to leave.

The positive and significant coefficients on Hispanic, Black, and Asian are unsurprising as charters disproportionately enroll minority students (Frankenberg, Siegel-Hawley, & Wang, 2010; Hoxby & Murarka, 2009). Given that students learn better from teachers with the same ethnicity (Dee, 2004), a teacher who wishes to be the most effective will choose to teach where she shares the ethnicity of the students.

The quality estimates imply that Higher Quality teachers are significantly more likely to work at a charter than their lowest quality counterparts. There is no effect for Lower Quality teachers.

Comparing the results in Column 1 to those in Column 2 to determine if the difference between the matched and reference year assignment of college ranks matters, the reference year produces a lower point estimate with a lower significance on the quality variables than the matched measure[13]. The discrepancies worsen in Column 3, which incorporates all teachers, including

those without a matched ranking. The additional teachers entered college before 1991, further from the reference year. These results represent what other studies using a reference year proxy would have found. The estimate for Higher Quality teachers is less than half of the previous estimates and is insignificant. The studies would have erroneously concluded there was no quality effect, while the matched ranking indicates that there is a quality effect.

Table 7
Probit Results of Charter School Participation & Teacher Quality, 2007-2008 Regular Teachers, Aggregated Quality

		2002 Ranks	
	Matched Quality	Matched Sample	All FT/PT Teachers
Higher Quality (=1)	0.2679***	0.2312**	0.1012
	(0.0962)	(0.0948)	(0.0709)
Lower Quality (=1)	0.0831	0.0344	-0.0477
	(0.0726)	(0.0891)	(0.0662)
Master's Degree (=1)	-0.1529***	-0.1576***	-0.1540***
	(0.0407)	(0.0408)	(0.0314)
PhD (=1)	-0.1688	-0.1788	0.2001
	(0.3389)	(0.3356)	(0.1420)
Years of Teaching Experience (decades)	-0.2963***	-0.3024***	-0.2833***
	(0.0483)	(0.0487)	(0.0257)
Female (=1)	0.1311***	0.1336***	0.0701**
	(0.0428)	(0.0429)	(0.0332)
Age (100s yrs)	-0.0461	-0.0259	0.2252
	(0.2607)	(0.2612)	(0.1777)
Hispanic (=1)	0.2610***	0.2662***	0.3023***
	(0.0725)	(0.0726)	(0.0597)
Black (=1)	0.4982***	0.5112***	0.4376***
	(0.0601)	(0.0603)	(0.0482)
Asian (=1)	0.3526***	0.3429***	0.3818***
	(0.1279)	(0.1275)	(0.1028)
Pacific Islander (=1)	0.3498*	0.3530*	0.1645
	(0.2116)	(0.2133)	(0.1963)
American Indian (=1)	-0.1011	-0.0988	-0.1520
	(0.1273)	(0.1275)	(0.1050)
Constant	-1.6538***	-1.6457***	-1.6035***
	(0.1121)	(0.1250)	(0.0905)
Observations	14030	14030	26510

Sample sizes rounded to nearest ten for confidentiality purposes.
Reporting probit estimates
Higher quality refers to teachers from Most and Highly Competitive colleges
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 reports the marginal effects of the probit presented in Table 7. For this population, the benchmark teacher is 36.4 years of age with 8.8 years of teaching experience. The probability of teaching at a charter for this population is 4.6%.

The first column indicates that teachers with Master's degrees are roughly one percentage point (22%) less likely to work at a charter. For each decade of teaching experience a teacher has, he is roughly 1.8 percentage points, or 39%, less likely to work at a charter school. Column 1 also finds that females are nearly 22% more likely to work at a charter school than males.

Table 8
Marginal Effects of Charter School Participation & Teacher Quality, 2007-2008 Regular Teachers, Aggregated Quality

		2002 Ranks	
	Matched Quality	Matched Sample	All FT/PT Teachers
Higher Quality (=1)	0.0214***	0.0182***	0.0074
	(0.0081)	(0.0067)	(0.0049)
Lower Quality (=1)	0.0056	0.0022	-0.0030
	(0.0046)	(0.0056)	(0.0044)
Master's Degree (=1)	-0.0082***	-0.0085***	-0.0088***
	(0.0024)	(0.0026)	(0.0021)
PhD (=1)	-0.0089	-0.0095	0.0160
	(0.0150)	(0.0149)	(0.0137)
Years of Teaching Experience (decades)	-0.0183***	-0.0191***	-0.0188***
	(0.0038)	(0.0042)	(0.0028)
Female (=1)	0.0092***	0.0096***	0.0050**
	(0.0031)	(0.0033)	(0.0024)
Age (100s yrs)	-0.0029	-0.0016	0.0149
	(0.0162)	(0.0165)	(0.0119)
Hispanic (=1)	0.0207***	0.0216***	0.0266***
	(0.0075)	(0.0079)	(0.0071)
Black (=1)	0.0492***	0.0520***	0.0435***
	(0.0102)	(0.0113)	(0.0079)
Asian (=1)	0.0305**	0.0299*	0.0361***
	(0.0152)	(0.0154)	(0.0137)
Pacific Islander (=1)	0.0302	0.0311	0.0127
	(0.0244)	(0.0253)	(0.0176)
American Indian (=1)	-0.0057	-0.0057	-0.0087
	(0.0066)	(0.0068)	(0.0054)
Observations	14030	14030	26510

Sample sizes rounded to nearest ten for confidentiality purposes.
Reporting marginal effects for benchmark teacher
Higher quality refers to teachers from Most and Highly Competitive colleges
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The biggest effect appears to be with respect to a teacher's race. Black teachers are 4.9 percentage points, or 107%, more likely to work at a charter than a White teacher. Hispanic

teachers are 2.1 percentage points (46%) more likely, and Asian teachers are 3.1 percentage points (67%) more likely to work at a charter than the White benchmark teacher.

Quantifying the quality effect, the Column 1 finds Higher Quality teachers from Most and Highly Competitive colleges are 2.1 percentage points, or 46%, more likely to work at a charter school than the lowest quality benchmark teacher from a Non Competitive college. Lower Quality teachers are not significantly more likely to work at a charter school than the benchmark.

The quality effect does not appear that large compared to other controls. While it is larger in magnitude than the effects of graduate degrees, gender, or years of experience, it is less than half the effect of being Black. The small magnitude of the quality effect may be reflecting the fact that teachers were aggregated into quality groups, something that will be investigated in Table 9.

For the reference year marginal effects, Column 2 indicates that Higher Quality teachers are 1.8 percentage points (39%) more likely to teach at a charter school than the benchmark teacher. There is still no effect for Lower Quality teachers. Again, incorporating all teachers in Column 3, the estimate is less than half of that in Column 2 and is insignificant.

While the previous tables illustrate that there is a quality effect, the question remains if finer distinctions of quality matter. Table 9 presents the marginal effects for the disaggregated quality estimation. The columns can be interpreted in the same manner as those of Tables 7 and 8.

Table 9 indicates that the aggregated quality analysis fails to pick up differences among the finer quality distinctions. Column 1 suggests that teachers from the Most Competitive colleges are 4.4 percentage points, or 96%, more likely to teach at a charter than those from Non Competitive colleges. Since schools desire the best teachers, this estimate reflects that these teachers are able to choose their ideal school. Thus, the 4.4 percentage point increase reflects these teachers' preferences for charters over traditional schools.

Highly and Very Competitive college graduates are 1.7 and 1.9 percentage points, or 37% and 41%, more likely to work at a charter than the benchmark teacher. These estimates are a combination of the teachers' preferences for charter positions given their availability. As quality declines, the point estimates decline as well, and teachers from Competitive and Less Competitive colleges are not significantly more likely to work at a charter. The insignificant result may reflect the fact that these teachers were not able to choose a charter school, as the positions may have been filled. As such, for these teachers, the estimate reflects availability more than preferences.

Table 9 also indicates that using the 2002 ranking continues to produce distorted estimates. The difference is greatest between the two measurements for teachers from Most and Very Competitive colleges. In Column 2, the reference year ranking indicates the Most Competitive graduates are 4.0 percentage points more likely to work at a charter, while Highly Competitive graduates no longer have a quality effect. Teachers from Very Competitive colleges are 1.6 percentage points more likely, while there is no quality effect for teachers from lower ranked schools.

The results suggest the probability of teaching at a charter over a public school generally increases as college-based quality increases. Aggregating quality leads to inaccurate conclusions. Using a reference year is more misleading for those graduating from the Most Competitive colleges, and it may change the significance of the findings.

Thus far, more experienced teachers appear less likely to choose a charter over a public school. Charters may have been perceived as risky ventures or as negative signals when they were first introduced. As such, the attraction to charter schools and the quality effect may be different among different cohorts of teachers depending upon when they started teaching. Table 10 presents the marginal effects of the probit regressions for different cohorts to determine if the quality effect

varies between them. A cohort is defined as the group of teachers matched to a Barron's publication year. For example, teachers who entered college in 1991 and 1992 are classified in the 1992 cohort. There are nine cohorts corresponding to the nine years of Barron's rankings in this study.

The matched ranking is the sole quality measure in the cohort analysis. Due to the small number of charter teachers in each cohort, this study combines some independent variables because of lack of variation. For example, it combines having a Master's or a Ph.D. into a dummy variable for graduate degrees which is equal to one if the teacher has either an M.A. or a Ph.D. For the 1969-1970 and 1993-1994 cohorts, it combines teachers from Most and Highly Competitive colleges due to a lack of variation in these categories for charter and traditional teachers. For other cohorts, such as 1983-1984 and 1985-1986, it combines teachers from Most, Highly, and Very Competitive colleges. When necessary, this study combines minority groups as "Other Ethnicity" due to the small number of minorities in certain cohorts.

Table 9
Marginal Effects of Teacher Quality & Charter School Participation, 2007-2008 Regular Teachers, Disaggregated Quality

		2002 Ranks	
	Matched Quality	Matched Sample	All FT/PT Teachers
Most Competitive College (=1)	0.0442**	0.0401***	0.0200**
	(0.0189)	(0.0151)	(0.0095)
Highly Competitive College (=1)	0.0173**	0.0125	0.0045
	(0.0084)	(0.0085)	(0.0061)
Very Competitive College (=1)	0.0185***	0.0162**	0.0060
	(0.0061)	(0.0067)	(0.0050)
Competitive College (=1)	0.0038	0.0023	-0.0031
	(0.0047)	(0.0058)	(0.0044)
Less Competitive College (=1)	0.0007	-0.0003	-0.0050
	(0.0051)	(0.0061)	(0.0047)
Master's Degree (=1)	-0.0087***	-0.0091***	-0.0092***
	(0.0024)	(0.0026)	(0.0021)
PhD (=1)	-0.0093	-0.0109	0.0140
	(0.0147)	(0.0142)	(0.0133)
Years of Teaching Experience (decades)	-0.0180***	-0.0189***	-0.0186***
	(0.0038)	(0.0042)	(0.0028)
Female (=1)	0.0096***	0.0098***	0.0052**
	(0.0031)	(0.0033)	(0.0024)
Age (100s yrs)	0.0039	0.0004	0.0149
	(0.0160)	(0.0165)	(0.0119)
Hispanic (=1)	0.0207***	0.0218***	0.0270***
	(0.0075)	(0.0079)	(0.0072)
Black (=1)	0.0514***	0.0531***	0.0445***
	(0.0106)	(0.0115)	(0.0080)
Asian (=1)	0.0282*	0.0272*	0.0340**
	(0.0147)	(0.0148)	(0.0133)
Pacific Islander (=1)	0.0311	0.0311	0.0126
	(0.0250)	(0.0254)	(0.0176)
American Indian (=1)	-0.0053	-0.0054	-0.0084
	(0.0066)	(0.0068)	(0.0055)
Observations	14030	14030	26510

Samples rounded to nearest ten for confidentiality purposes.
Reporting marginal effects for bench mark case
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The marginal effects for each cohort presented in Table 10 are in reference to a benchmark teacher for that cohort[14]. All coefficients on the controls exhibit the expected sign. The quality effect is absent for older teachers, as expected, since these teachers would have already found their ideal school by the time charters were established. The quality effect first appears in 1997, though there is a slight negative effect for teachers from Highly Competitive colleges who entered in

1995-1996.

Table 10
Marginal Effects Estimates of Teacher Quality & Charter Participation, 2007-2008 Teachers, by Cohort

	Cohort Group								
	1969-1970[a]	1983-1984	1985-1986	1991-1992	1993-1994	1995-1996	1997-1998	1999-2000	2001-2002
Most Competitive College (=1)				0.0436		0.0548	0.0991	0.1107*	0.1156*
				(0.0615)		(0.0655)	(0.0692)	(0.0630)	(0.0660)
Highly Competitive College (=1)	0.0022[b]			0.0281	0.0017[b]	-0.0300*	0.0922***	0.0612**	0.0014
	(0.0081)			(0.0268)	(0.0271)	(0.0157)	(0.0335)	(0.0300)	(0.0255)
Very Competitive College (=1)	-0.0006	-0.0078[d]	-0.0016[d]	0.0263	0.0045	-0.0036	0.0693***	0.0381**	0.0228
	(0.0044)	(0.0162)	(0.0034)	(0.0165)	(0.0231)	(0.0156)	(0.0224)	(0.0189)	(0.0223)
Competitive (=1)	-0.0013	-0.0035	-0.0003	0.0118	-0.0123	-0.0132	0.0270*	0.0143	0.0142
	(0.0029)	(0.0148)	(0.0031)	(0.0098)	(0.0184)	(0.0138)	(0.0150)	(0.0147)	(0.0190)
Less Competitive (=1)		-0.0050	-0.0032	0.0108	0.0138	-0.0119	0.0063	0.0018	-0.0034
		(0.0154)	(0.0036)	(0.0106)	(0.0228)	(0.0145)	(0.0160)	(0.0157)	(0.0198)
Graduate Degree (MA/PhD) (=1)	0.0038	0.0029	0.0002	-0.0073	-0.0184*	-0.0187**	-0.0048	-0.0181**	0.0041
	(0.0049)	(0.0096)	(0.0022)	(0.0055)	(0.0110)	(0.0092)	(0.0054)	(0.0086)	(0.0140)
Yrs Teaching Exper. (decades)	-0.0021	-0.0233*	-0.0039	-0.0278	-0.0500**	-0.0354	-0.0360*	-0.0004	-0.0077
	(0.0022)	(0.0142)	(0.0035)	(0.0190)	(0.0227)	(0.0237)	(0.0215)	(0.0239)	(0.0357)
Female (=1)	0.0077*	0.0082	0.0303**	0.0120	0.0020	0.0433**	-0.0074	0.0149	0.0053
	(0.0044)	(0.0118)	(0.0154)	(0.0080)	(0.0114)	(0.0172)	(0.0061)	(0.0095)	(0.0093)
Age (100s yrs)	0.0551	-0.0050	-0.0033	0.0639	-0.1230	0.0456	-0.0374	-0.0569	0.0100
	(0.0672)	(0.0905)	(0.0173)	(0.0500)	(0.0931)	(0.0660)	(0.0584)	(0.0615)	(0.0638)
Hispanic (=1)	0.0095	0.0181	-0.0032	0.0103	0.0045	0.0343	0.0417	0.0179	0.0429
	(0.0172)	(0.0297)	(0.0035)	(0.0137)	(0.0232)	(0.0294)	(0.0271)	(0.0183)	(0.0272)
Black (=1)	-0.0017	0.0119	0.0261	0.0186	0.0876**	0.0838**	0.0351	0.0872**	0.0551
	(0.0051)	(0.0231)	(0.0233)	(0.0164)	(0.0397)	(0.0359)	(0.0217)	(0.0346)	(0.0342)
Asian (=1)	0.1834		0.0226	-0.0006	0.0944	0.0918		-0.0029	0.0230
	(0.2253)		(0.0359)	(0.0149)	(0.0718)	(0.0634)		(0.0191)	(0.0414)
Pacific Islander (=1)						0.0961		0.0109	0.0653
						(0.0969)		(0.0519)	(0.1155)
American Indian (=1)						0.0036		-0.0184	-0.0155
						(0.0231)		(0.0154)	(0.0213)
Other Ethnicity (=1)	0.0076[c]	0.0074[e]	0.0141[c]	-0.0087[c]	0.0391[c]		-0.0165[e]		
	(0.0170)	(0.0319)	(0.0182)	(0.0075)	(0.0410)		(0.0107)		
Observations	1230	980	1300	1470	1630	1780	1920	1980	1750

[a] Reference group is teachers from Less and Non Competitive colleges due to few observations.
[b] Estimate is for teachers from Most and Highly Competitive colleges due to few observations for Most Competitive colleges.
[c] Other ethnicity includes American Indians and Pacific Islanders.
[d] Estimate is for teachers from Most, Highly and Very Competitive colleges due to lack of observations
[e] Other ethnicity includes Asians as well as American Indians and Pacific Islanders.
Sample sizes rounded to nearest 10 for confidentiality purposes
Reporting marginal effects for benchmark case.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The quality effect is largest among the most recent college graduates and those from the highest ranked colleges. Among those who entered college in 2001-2002 and who graduated in 2005-2006, the probability of teaching at a charter is 6.4%. For these teachers, those from Most Competitive colleges are 11.6 percentage points, or 180%, more likely to teach at a charter than their benchmark teacher.

For those who entered college in 1999-2000, the probability of teaching at a charter is 7.0%. Those from Most Competitive colleges are 11.1 percentage points, or 159%, more likely to teach at a charter, compared to their benchmark. Highly Competitive and Very Competitive college graduates are 6.1 (87%) and 3.8 (54%) percentage points more likely to teach at a charter.

For those entering in 1997-1998, the probability of teaching at a charter is 5.3%. Teachers from Highly Competitive colleges are 9.2 percentage points more likely to teach at a charter than their benchmark. Those from Very Competitive and Competitive colleges are 6.9 and 2.7

percentage points more likely.

The results from these three cohorts imply that the quality effect on charter school preferences is stronger in more recent cohorts. In particular, for the two most recent cohorts, teachers from the best colleges have the largest increase in the probability of teaching a charter school. These results are important because if the highest quality teachers in the youngest cohorts are significantly more likely to prefer a charter school, this may be affecting the quality level of public school teachers. Furthermore, as older teachers retire, the quality effect on public schools may become larger.

Persistence: 2003-2004 SASS Findings

While the SASS does not follow the same teachers across waves, it is designed to be representative. As such, data from the 2003-2004 SASS along with data from the 2007-2008 SASS allow this study to observe many of the same cohorts at two different points in time. The most recent cohort in the later data is not in the 2003-2004 data, as these teachers were just entering college at that time. A cohort analysis[15] applied to the earlier data explores if the patterns observed in the most recent data persist. This analysis implements the same methodology to identify the matched rankings. The sample of regular teachers educated in charter states who have a matched ranking is 13,340.

The results for the cohort analysis using the earlier data are presented in Table 11. The marginal effects are calculated in comparison to a benchmark teacher for each cohort. This study combined quality measures and ethnicities for certain cohorts due to lack of variation in independent variables.

The estimates suggest that the quality effect is nonexistent for teachers who entered college prior to 1991, as was true for the cohort analysis using the 2007-2008 SASS data. For the 1991-1992 cohort, the magnitudes of the quality effect appears similar for both the 2003-2004 and the 2007-2008 analysis, with the exception of those teachers graduating from Competitive colleges being slightly more likely to teach at a charter in the 2003-2004 data. Generally, for older cohorts, decisions appear to be persistent.

Interestingly, for teachers in the 1993-1994 and 1995-1996 cohorts who graduated between 1997-2000, the 2003-2004 data suggest there was a quality effect for Highly, Very, and Competitive college graduates. By 2007-2008, the effect seems to have disappeared (Table 10). The opposite appears to be true for the 1997-1998 cohort. Among those from Most Competitive colleges, the estimates appear similar in magnitude. For graduates from Highly, Very, and Competitive colleges, the magnitudes of the effects appear to increase over time. The few observations in the latest cohort of the 2003-2004 data make comparisons across the analyses difficult.

The estimates in Table 11 imply that for the majority of cohorts, the patterns appear to hold over time. The probability of teaching at a charter generally increases with college-based quality. The probabilities for higher quality teachers increase in magnitude the younger the cohort. These findings imply that as cohorts retire, the distribution of teacher quality, based on college competitiveness, in public schools may be increasingly skewed towards those graduating from lower-ranked colleges as those from more competitive colleges choose charter schools.

Table 11
Marginal Effects Estimates of Teacher Quality & Charter Participation, 2003-2004 Teachers, by Cohort

	Cohort Group							
	1969-1970	1983-1984	1985-1986	1991-1992	1993-1994	1995-1996	1997-1998	1999-2000[c]
Most Competitive College (=1)		0.1519		0.0534	0.0899	0.0790	0.1059*	
		(0.1103)		(0.0421)	(0.0791)	(0.0685)	(0.0582)	
Highly Competitive College (=1)	-0.0213[a]	0.0095		0.0290	0.0695**	0.0572***	0.0398***	0.0188[a]
	(0.0313)	(0.0230)		(0.0226)	(0.0310)	(0.0180)	(0.0149)	(0.0425)
Very Competitive College (=1)	-0.0001	0.0219	0.0004[c]	0.0242**	0.0515**	0.0627**	0.0240	0.0616
	(0.0318)	(0.0152)	(0.0024)	(0.0114)	(0.0215)	(0.0285)	(0.0182)	(0.0428)
Competitive (=1)	-0.0157	0.0074	0.0054	0.0263***	0.0358**	0.0312***	0.0126	0.0421
	(0.0301)	(0.0102)	(0.0042)	(0.0091)	(0.0149)	(0.0109)	(0.0092)	(0.0297)
Less Competitive (=1)	-0.0155	-0.0040	-0.0006	0.0130*	0.0216	0.0243**	0.0169	-0.0161
	(0.0302)	(0.0102)	(0.0022)	(0.0078)	(0.0167)	(0.0124)	(0.0118)	(0.0226)
Graduate Degree (MA/PhD) (=1)	-0.0073	-0.0048	-0.0007	-0.0034	-0.0063	-0.0061	-0.0062	
	(0.0132)	(0.0051)	(0.0010)	(0.0025)	(0.0055)	(0.0041)	(0.0062)	
Yrs Teaching Exper. (decades)	-0.0360	-0.0123	-0.0071	-0.0248	-0.0430*	-0.0303	-0.0256	0.0893
	(0.0354)	(0.0107)	(0.0056)	(0.0165)	(0.0247)	(0.0197)	(0.0180)	(0.0626)
Female (=1)	-0.0165	0.0056	0.0122	0.0024	-0.0077	0.0002	0.0089	-0.0054
	(0.1828)	(0.0071)	(0.0075)	(0.0030)	(0.0059)	(0.0036)	(0.0059)	(0.0140)
Age (100s yrs)	-0.1850	0.0625	0.0041	-0.0063	0.0377	0.0129	0.0401	0.0515
	(0.3755)	(0.0655)	(0.0084)	(0.0176)	(0.0401)	(0.0270)	(0.0337)	(0.0933)
Hispanic (=1)		0.0371	-0.0006	0.0149	0.0219	0.0313	0.0376*	0.0281
		(0.0367)	(0.0019)	(0.0122)	(0.0192)	(0.0202)	(0.0225)	(0.0424)
Black (=1)			0.0022	0.0396*	0.0258	0.0535**	0.0691**	0.0172
			(0.0040)	(0.0219)	(0.0181)	(0.0254)	(0.0303)	(0.0329)
Asian (=1)			-0.0014	0.0030	0.0006	-0.0025	0.0038	-0.0059
			(0.0020)	(0.0068)	(0.0129)	(0.0078)	(0.0125)	(0.0311)
Pacific Islander (=1)			0.0784	0.0178		-0.0038	-0.0039	
			(0.0809)	(0.0208)		(0.0140)	(0.0165)	
American Indian (=1)			0.0003	0.0026		0.0072	-0.0036	
			(0.0032)	(0.0059)		(0.0131)	(0.0101)	
Other Ethnicity (=1)	-0.0051	-0.0008[b]			-0.0062[d]			0.0148[d]
	0.01625	(0.0078)			(0.0106)			(0.0391)
Observations	1820	1270	1560	2090	2050	2190	1860	510

[a] Refers to estimate for teachers from Most and Highly Competitive colleges grouped together due to few observations.

[b] Other ethnicity includes Blacks, Asians, Pacific Islanders, and American Indians.

[c] Refers to the estimate for teachers from Most, Highly, and Very Competitive colleges grouped together due to few observations.

[d] Other Ethnicity includes Pacific Islanders and American Indians.

[e] Graduate degree was not included due to collinearity.

Sample sizes rounded to nearest 10 for confidentiality purposes

Reporting marginal effects for benchmark case.

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

CONCLUSIONS

This paper uses a disaggregated measure of teacher quality based on the competitiveness of a teacher's college as measured by *Barron's Profiles of American Colleges* to determine how different quality teachers sort between public and charter schools. The findings reveal that teachers from better colleges are more likely to teach at a charter than at a public school. This probability increases with college competitiveness. The greatest impact is on the youngest and newest teachers, with the highest quality ones being roughly 11 percentage points more likely to teach at a charter over their lowest quality counterparts. Quality effects are nonexistent for older teachers. School choice patterns appear relatively persistent over time given a subsequent analysis using the 2003-2004 SASS data, as the magnitudes of the quality effects for most cohorts generally appear similar between the two datasets.

This paper further investigates how to most appropriately proxy for teacher quality using undergraduate college ranking. It finds that aggregating quality levels can mask effects of finer quality distinctions and lead to erroneous conclusions and biased results. Furthermore, this study illustrates that competitiveness and rankings are dynamic; using a single reference year to measure competitiveness can result in measurement error, be misleading, and distort results. The distortion consistently underestimates the differences in choosing a charter for each quality distinction. The distortion becomes more pronounced the further the reference year is from when teachers actually entered college.

Few teachers hail from the best institutions. Since teacher quality affects student outcomes, knowing where newer and better quality teachers' preferences lay may illuminate how to attract such teachers. Since these teachers are disproportionately choosing charter schools, public schools must ask why these teachers are choosing the charter bundle.

ENDNOTES

1 Some studies use the average SAT/ACT score of where the teacher attended college instead of the college's competitiveness rank. See, for example, Figlio (2002), Hoxby and Leigh (2004), and Podgursky et al. (2004).

2 Two states passed laws in 1991 and 1992. Six passed laws in 1993, three in 1994, eight in 1995, seven in 1996, four in 1997, five in 1998, two in 1999, one in 2001, two in 2002, and one in 2003 (Center for Education Reform, 2010).

3 One could argue that competitiveness changes over time are simply due to increases in the demand for higher education and do not actually reflect increases in university quality; however, the Barron's rankings are based on a stringent set of characteristics that remains stable over time. Thus, school quality may be increasing as schools are able to accept a lower percentage of applicants with higher test scores, class ranks, and GPAs.

4 This study is therefore losing cohorts of teachers, not individual teachers. Furthermore, the cohorts that are dropped from the analysis are generally older. These cohorts likely will have already established tenure at their schools and therefore are of little interest to this study. The few earlier cohorts included in the analysis illustrate this point.

5 For confidentiality and due to license requirements, all sample sizes are rounded to the nearest 10.

6 This paper excluded long- and short-term substitutes and teacher aides from the analysis.

7 All analyses have been carried out using all states, including charter and non-charter states, as well as using only teachers teaching in charter states. The general results hold for all analyses.

8 The actual SASS responses to questions pertaining to perceptions are coded with a 1 corresponding to "Strongly agree" and a 4 corresponding to "Strongly disagree". For ease of interpretation, this study recoded the variables by inverting the responses.

9 Though charter schools are not uniformly distributed across charter states, it is also assumed that teachers are able to accept employment at a charter if desired.

10 All teachers have their undergraduate degrees in the analysis, so the comparison is to teachers without any graduate degree.

11 The models were also estimated with controls for teachers' certification status; however, certification could be endogenous. As such, those results are not included in this paper. The estimates are available upon request. The general results and conclusions of this paper hold when controlling for certification status.

12 Teachers without a matched measure are teachers who entered college in a year for which the Barron's rankings are not included in this study.

13 The analyses were also carried out using the 2000 ranks as the reference year for columns 2 and 3, and the results and conclusions hold.

14 Recall the benchmark teacher is a White male of the lowest quality and of average age with the average number of years of experience for that particular cohort.

15 The study replicated all previous analyses using the 2007-2008 data with the 2003-2004 data. The general results hold and are available upon request.

ACKNOWLEDGEMENTS

I am grateful to Jeffrey Zax for his guidance and comments. I would also like to thank Francisca Antman, Brian Cadena, Rey Hernandez, and Terra McKinnish for helpful comments and suggestions. Special thanks to participants of the 32nd Annual APPAM Fall Conferences, the 80th Annual SEA Meetings, and the Colby College Seminar Series for helpful comments. Any remaining errors are my own.

REFERENCES

Aaronson, D., L. Barrow, & Sander, W. (2002). Teachers and student achievement in the Chicago public high schools. Federal Reserve Bank of Chicago, Working Paper Series WP-02-28.

Angrist, J.D., & Guryan, J. (2008). Does teacher testing raise teacher quality? Evidence from state certification requirements. *Economics of Education Review* 27(5), 483-503.

Angrist, J.D., & Guryan, J. (2004). Teacher testing, teacher education, and teacher characteristics. *American Economic Review* 94(2):241-246.

Bacolod, M. (2007a). Do alternative opportunities matter? The role of female labor markets in the decline of teacher quality. *Review of Economics and Statistics* 89(4),737-778.

Bacolod, M. (2007b). Who teaches and where they choose to teach: College graduates of the 1990s. *Educational Evaluation and Policy Analysis* 29(3),155-168.

Baker, B.D., & Dickerson, J.L. (2006). Charter schools, teacher labor market deregulation, and teacher quality. *Educational Policy* 20(5), 752-778.

Ballou, D. (1996). Do public schools hire the best applicants? *Quarterly Journal of Economics* 11(1),97-133.

Ballou, D., & Podgursky, M.. (1997). *Teacher pay and teacher quality.* Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Ballou, Dale, & Podgursky, M. (1995). Recruiting smarter teachers. *Journal of Human Resources* 30(2),326-338.

Berliner, D. (2005). The near impossibility of testing for teacher quality. *Journal of Teacher Education* 56(3), 205-213.

Boyd, D., Lankford, H., Loeb S., Ronfeldt, M., & Wyckoff, J. (2010). The role of teacher quality in retention and Hand hiring: using applications-to-transfer to uncover preferences of teachers and schools. *Journal of Policy Analysis and Management* 30(1),88-110.

Boyd, D., Lankford, H., Loeb S., & Wyckoff, J. (2005). The draw of home: how teachers' preferences for proximity disadvantage urban schools. *Journal of Policy Analysis and Management* 24(1),113-132.

Boyd, D., Lankford, H., Loeb S., & Wyckoff, J. (2003). *Analysing the determinants of the matching of public school teachers to jobs: Estimating compensating differentials in imperfect labor markets.* NBER Working Paper 9878.

Carruthers, Celeste K. (2009). *The Qualifications and Classroom Performance of Teachers Moving to Charter Schools.* CALDER Working Paper 27.

Center for Education Reform. (2010). *Just the FAQs - charter schools.* Retrieved June 2010 from <http://www.edreform.com/published_pdf/Just_the_FAQs_Charter_Schools.pdf>.

Coleman, J. S., Campbell, E.Q., Hobson, C.J., McPartland, J., Mood, A.M., Weinfeld, F.D., et al. (1966). *Equality of educational opportunity.* Washington, D.C.: U.S. Government Printing Office.

Clotfelter, C.T., Ladd, H.F., & Vidgor, J.L. (2006). Teacher-student matching and the assessment of teacher effectiveness. *The Journal of Human Resources* 41(4),778-820.

Dee, T.S. (2004). The race connection: are teachers more effective with students who share their ethnicity? *Education Next* 2,52-59.

Dillon, S. (2010). Scholar's school reform U-turn shakes up debate. *The New York Times*. Retrieved March 2013 from : http://www.nytimes.com/2010/03/03/education/03ravitch.html?pagewanted=all.

Dye, R.A., & Antle, R. 1984. Self-selection via fringe benefits. *Journal of Labor Economics 2(3),388-410.*

Ehrenberg, R., & Brewer, D. (1994). Do school and teacher characteristics matter? Evidence from *High School and Beyond*. *Economics of Education Review* 13(1), 1-17.

Ferguson, R.F. (1991). Paying for public education: New evidence on how and why money matters. *Harvard Journal on Legislation* 28(465),465-498.

Ferguson, R.F. & Ladd, H.F. 1996. How and Why Money Matters: An Analysis of Alabama Schools. In H.F. Ladd, *Holding schools accountable: Performance-based reform in education (pp. 256-298).* Washington, D.C.: The Brookings Institution.

Figlio, D.N. (2002). Can public Schools buy better-qualified teachers. *Industrial and Labor Relations Review* 55(4),686-699.

Figlio, D.N. (1997). Teacher salaries and teacher quality. *Economic Letters* 55, 267-271.

Frankenberg, E., Siegel-Hawley, G., & Wang, J. (2010). *Choice without equity: Charter school segregation and the need for civil rights standards.* Los Angeles, CA: The Civil Rights Project/Proyecto Derechos Civiles at UCLA. Retrieved July 2010 from www.civilrightsproject.ucla.edu.

Goldhaber, D. (2002). The mystery of good teaching: Surveying the evidence on student achievement and teachers' characteristics. *Education Next* 2(1),50-55.

Hanushek, E.A. (1971). Teacher characteristics and gains in student achievement: Estimation using micro data. *American Economic Review*: 61(2),280-288.

Hanushek, E.A. & Pace, R.R. (1995). Who chooses to teach (and why)? *Economics of Education Review* 14(2),1010-117.

Hanushek, E.A. Kain, J.F., & Rivkin, S.G. (2003). Does Public School Competition Affect Teacher Quality? In C.M. Hoxby, *The Economics of School Choice* (pp. 23-47). Chicago: University of Chicago Press.

Hoxby, C.M. (2002). Would school choice change the teaching profession? *The Journal of Human Resources* 37(4),846-891.

Hoxby, C.M. & Leigh, A. (2004). Pulled away or pushed out? Explaining the decline of teacher quality in the U.S. *American Economic Review* 94(2),236-240.

Hoxby, C.M., & Murarka, S. (2009). *Charter schools in New York City: Who enrolls and how they affect their students' achievement.* NBER Working Paper 14852

Lankford, H., Loeb, S., & Wyckoff, J. (2002). Teacher sorting and the plight of urban schools:

A descriptive analysis. *Educational Evaluation and Policy Analysis* 24(1),37-62.

Podgursky, M., Monroe, R., & Watson, D. (2004). The academic quality of public school teachers: An analysis of Entry and exit behavior. *Economics of Education Review* 23(5),507-518.

Rivkin, S.G., Hanushek, E.A., & Kain, J.F. (2005). Teachers, schools, and academic achievement. *Econometrica* 73(2),417-458.

Rockoff, J.E. (2004). "The impact of individual teachers on student achievement: Evidence from panel data. *American Economic Review* 94(2),247-252.

REVISITING MONEY DEMAND FUNCTION FOR GCC COUNTRIES AND TESTING ITS STABILITY

Haider Mahmood, Prince Sattam bin Abdulaziz University

ABSTRACT

A money demand's stability is necessary condition in choosing the appropriate monetary policy. The present study has investigated the most important determinants of money demand by using a period of 1980-2014 for a panel of Gulf Cooperation Council (GCC) countries and has also tested its stability. A unit root analysis has confirmed the mix order of integration. In the long run relationships, income and exchange rate have positive influences on money demand and inflation and interest rates are showing the negative influences. In the short run analysis, income is observed as sole determinant of money demand. Further, estimated model holds stable.

Key Words: Money Demand, Monetary Policy, Cointegration, Stability

JEL Codes: E41, E52, C22, C62

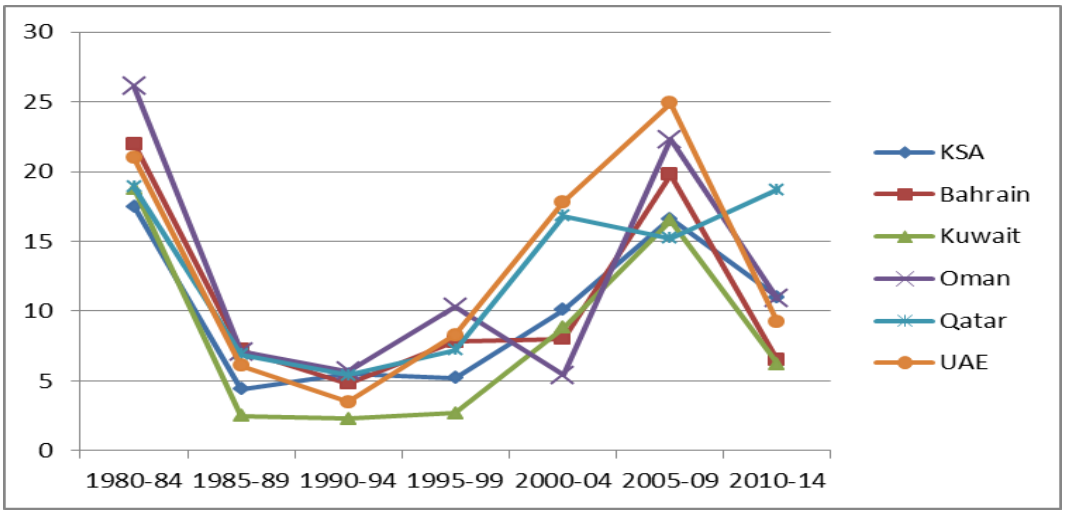
INTRODUCTION

A wrong instrument in opting monetary policy can cause a bad effect on economy at large. It is, therefore, inevitable to investigate the money demand's stability as it tends to help in setting appropriate monetary policy. Major determinants of money demand play vital role in enacting and deciding most relevant monetary policy instrument by competent authority i.e. the central bank of any country (Goldfeld, 1994). Following it, while Poole (1970) argued in the favour of money supply as policy instrument in case of a stable Money Demand Function (MDF). At the same pace financial reforms, financial innovations and financial crises are becoming the major reason of MDF instability. As there are many unknown structural breaks in any economy these appear in the wake of development of financial market and financial liberalization. Furthermore, financial market development and financial liberalization have changed the shape of money demand and its velocity. Alike, financial crises also likened to have a great impact. For example, East Asian financial crises of 1997-98 and global financial crises of 2007-08 poured such effects on the stability of MDF in most of the world economies. So the GCC countries are no more exception to it. Therefore, there is a dire need to capture the impact of such financial fluctuations (structural breaks) in the estimation of MDF for any economy and it becomes a worthy cause to suggest the right monetary policy instrument to meet macroeconomic policy objectives. Every economy has its own characteristics that may cater to shape the MDF, for example, economic growth targets, exchange rate devaluation and inflation and bank rates targeting. These versatile determinants change the requirement of money demand, significantly. Many other factors other than aforementioned cannot be ignored along while investigating MDF as per economy. In case of GCC, financial market of GCC countries has a significant share in their GDP and it is also sharply rising. The financial market is not only adaptable to modern requirements of the present

age (financial market development) but also faces some structural shocks from external world as well. Aside with the discussion of demand side conditions of money, the governments of GCC countries have also their own policy objectives to monitor the supply side conditions of money to meet the challenges rising from local problem such as output gap due to high unemployment. The all international and local circumstances are changing the demand and supply conditions of money demand and are motivating researchers and policy makers to find a true MDF for any economy to suggest the right instrument and magnitude of monetary policy.

In the discussion of money supply variability in GCC countries, Figure 1 shows the money supply (M2) average percentage carrying five years' growth rates for GCC countries and is depicting very high volatility in money supply throughout the selected period. The figure shows that the period in which money growth rates remain very high i.e. period of 1980-84 counts as first phase of financial market development in all GCC countries and it significantly acts to spur money demand and money supply, resultantly. A highest rate has been observed for Bahrain that is 22% and even least rate is very high, that is 17.5% for KSA. Afterwards, the growth rate suddenly falls in 1985-89 and remains stable for the 1990-94, afterwards. But, it shoots up again in 1995-99 except with a slight downturn in KSA. After 1995-99, the growth rates keep on rising at a greater pace except with a significant fall in growth rate of Oman and highest growth rate is observed for UAE in 2000-04. In the period 2005-09, all countries' growth rates show positive trends except a minute fall in case of Qatar and highest rate is again remained for UAE that is about 25%. This period, significantly, calls into mind the memories of financial crises of the world that currently has hit GCC countries as well. GCC countries, in response, are trying to stabilize the economies through floating more money supply, deliberately. Returning to graph, after the financial crises period, the growth rates tend to fall again in all countries except with a rise in Qatar. The graph shows a high variability in the money supply growth rates that are seems to be affected by the requisites of money demand and government's policy objectives. Therefore, the present study is highly motivated to quantify the major determinants of money demand in GCC countries.

Figure 1
Money Supply (M2) Average Percentage Carrying Five Years' Growth Rates



To deal with most important determinants of money demand and to verify the stability of MDF in GCC countries, the present study uses panel unit root test and Pooled Mean Group (PMG)

estimators by utilizing the annual data of a period 1980-2014. In this long time spam, structural breaks are likely to exist due to some local and/or international events. Further, GCC countries are still adopting the policy of financial market development to diversify their economies from oil-dependence. That can also be responsible for structural breaks in the MDF and may create biasness in estimation of long run parameters of MDF if not taken care. Therefore, the present study is aimed at capturing such breaks and is incorporating these effects in MDF to ensure the reliability of estimations. It is targeted to find separate breaks for each country and their incorporation in long run regression. This is necessary and being justified on a fact that financial reforms/ financial crises are not bound to happen at a single point of time.

REVIEW OF PANEL STUDIES

There has been a vast literature on the MDF and its stability. The whole literature may be explained into two dimensions. First dimension is investigated the MDF but not dealing with the stability issue, for example Mark and Sul (2003), Akinkunmi (2004), Dreger et al. (2007), Carrera (2012) and Hamdi et al. (2015). Mark and Sul (2003) investigate the MDF for nineteen- OECD countries for a period 1957-1996 by applying Dynamic Ordinary Least Square (DOLS). They find a positive income elasticity and a negative interest rate semi-elasticity less than one. Akinkunmi (2004) investigates the MDF for 36 developing economies and has compared the dynamic panel results with the country-specific results. In the both kind of analyses, he finds the negative interest rate and inflation elasticities and a positive income elasticity. Dreger et al. (2007) investigate the MDF for ten European economies by using the quarterly data of a period 1995-2004. They employ the panel dynamic estimate technique after doing the integration analysis and cointegration analysis to compare US dollar exchange rate and Euro exchange rate with the ordinary determinants like interest rate and income in the MDF. They find a positive income elasticity greater than one and a negative interest rate elasticity less than one. Further, they find a negative and significant dollar exchange rate elasticity and an insignificant Euro exchange rate elasticity. Therefore, they conclude dollar exchange rate as a more appropriate determinant of MDF of Euro region. Carrera (2012) estimates the MDF for fifteen Latin American states by using data of a time period 1948-2003. He applies individual country analysis and also panel group FMOLS on the group of all countries. In case of individual country analysis, he finds expected impacts of income and interest rate. For the panel results, he finds a unitary positive income elasticity and a very low negative interest rate elasticity. Hamdi et al. (2015) investigate the MDF for GCC countries for a period 1980-2011. They find a positive income elasticity less than one, negative interest rate elasticity less than one and insignificant behavior of exchange rate in MDF.

The second group of studies focus the stability of MDF along with the discussion of its determinants, for example, Narayan et al. (2009), Bahmani-Oskooee and Rehman (2005), Mahmood and Asif (2016) and Bahmani-Oskooee and Gelan (2009). Narayan et al. (2009) investigate the MDF for five South Asian economies by using a time period 1974-2002 by individual country analysis and panel data analysis. After doing the integration analysis and confirming the cointegration, they find a positive income elastic effect in case of India, Pakistan, Sri Lanka and Nepal but inelastic in case of Bangladesh. A positive elasticity of real exchange rate has been found in all cases with minute magnitudes. In the short run, interest rate has negative and inelastic influence in case of Bangladesh and India. A positive inelasticity of inflation has been found in all cases except India. In case of panel results, income, real exchange rate and inflation have positively determined the money demand and interest rate has a negative impact. Further, the money demand functions of Bangladesh, India and Sri Lanka have been found stable and that

proves unstable for rest of countries. Bahmani-Oskooee and Rehman (2005) estimate the stability of MDF for Asian developing economies by using quarterly data of a period 1973-2000 by applying the cointegration on determinants of M1 and M2.They apply the stability tests in the individual country analysis. They find that M1 and M2 proxies of money demand remain cointegrated with its determinants but show the unstable functions for most of the countries in their analysis. Bahmani-Oskooee and Gelan (2009) repeat these analyses for 21 African economies by using quarterly series for a period of 1971-2004. They test the stability tests on the estimated results for each country separately and conclude the stable MDFs for all countries. Mahmood and Asif (2016) estimate the MDF for GCC country in the time series setting of individual country and found the stable MDF for Saudi Arabia and Oman.

Further, some of the studies also pay heed to structural breaks in MDF while investigating the stability. Rao et al. (2009) estimate the MDF by using GMM estimates for a time period 1970-2007 for eleven Asian economies after incorporating the dummies for breaks. They find a positive inelastic impact of income on money demand and negative interest rate elastic, negative inflation elastic and negative exchange rate elastic impacts on money demand. They also confirm the stability of MDF. Kumar et al. (2013) investigate MDF for eleven OECD countries by applying panel cointegration test and structural break test. They find positive elastic behavior of income and negative interest rate inelastic effect on money demand. Further, with sub sample of break periods, they find that after structural break, income parameter decreases and interest rate parameter increases. They also claim that MDF has been found stable after considering the structural breaks in function.

In the conclusion of the literature review, it may be deduced that some of the studies have followed the methodology of finding structural breaks and also include these breaks in the cointegration of MDF to check the stability of the money. The studies which do not use the structural break tests, couldn't remain very clear in the conclusion for the policy recommendation. There is no single study to investigate stability of MDF in case of a panel of GCC countries though Hamdi et al. (2015) has investigated the MDF in a panel setting but do not inculcate structural breaks in analysis and also do not apply any stability test to ensure this issue. Therefore, the present study is going to fill this gap by finding the major drivers of money demand and it is also aiming at to find and to include the effect of most significant structural breaks in long run panel data analysis.

DATA, MODEL AND ECONOMETRIC STRATEGY

Following the empirical literature, the present study signifies the following function to estimate the MDF:

$$LMD_{it} = f(LY_{it}, R_{it}, P_{it}, ER_{it}, D_{it}) \quad (1)$$

where,

LMD_{it} = Logarithm of Money Demand (proxied by *M2*)
LY_{it} = Log of Real Gross Domestic Product proxy for national income
R_{it} = Real interest rate
P_{it} = Inflation rate
ER_{it} = Real Exchange Rate
D_{it} = Dummies to capture the possible breaks in the cointegration

The annual data on all variables for a period 1980-2014 has been collected from World Development Indicators (WDI).

Im et al. (2003) Test

The first step, in any time series or panel data estimation, is to test the stationarity of the series. As, non-stationarity can produce biased estimations. Im et al. (2003) test has been adopted the following equation to deal with this issue and to control the effect of heterogeneity:

$$\Delta Z_{it} = \beta_i + \rho Z_{it-1} + \sum_{k=1}^{n} \Delta Z_{it-k} + \lambda_{it} + \sigma_i + u_{it} \quad (2)$$

Here, Z will take the single variable for unit root test and the null hypothesis ($\rho = 0$) is of a unit root problem in series. This test is known as IPS test.

Bai and Perron Multiple Breakpoint Tests

There can be some unknown structural breaks in the time series. These can be responsible for the misleading results. Therefore, the consideration of these breaks in analysis is very important for the true estimations. Bai and Perron (2003) develop the test to find the most significant breaks with n possible breaks in T time period.

$$z_t = \alpha_i' x_t + u_t \quad (3)$$

where, regimes $i=1, 2, \ldots, n+1$. z_t contains matrix of LMD_t variable. x_t comprises of vector containing LY_t, R_t, ER_t and P_t. u_t is standard error.

Bai and Perron test propose the three option to estimate the break points, the present study focus on the Global maximizer tests. The test uses sums of square of residuals from the long run relationship.

$$\text{Sum}\left(\alpha/\text{T}\right) = \sum_{\text{i}=0}^{\text{n}} \left(\sum_{t-T_i}^{T_{i+1}-1} z_t - x_t' \alpha_i\right) \quad (4)$$

The global break test chooses the breaks with minimum sum of square across n break partitions.

Mean Group (MG) and Pooled Mean Group (PMG)

The standard fixed effects and random effects are not enough and may give the spurious results due to the possible endogeneity in the model. Therefore, the dynamic relationship can be estimated through MG and PMG estimators to avoid the endogeneity problem in the model.

Pesaran et al. (1999) extends the PMG estimators by averaging and pooling. In the cross sections, PMG allows the deviation in the intercept and other parameters. PMG estimators are the re-parameterization of ARDL model. Therefore, these are efficient even in case of mix order of integration. The ARDL (p, q) model for the estimation of PMG estimators is as follows:

$$\text{z}_{\text{it}} = \delta_i + \sum_{i=1}^{q} \alpha_i z_{i,t-1} + \sum_{i=0}^{p} \theta_i x_{i,t-1} + \varepsilon_{it} \quad (5)$$

The model can be estimated z and x approach to their steady-state points:

$$\text{z}^* = \beta_0 + \beta_1 x^* \quad (6)$$

The long run estimation can be:

$$\text{z}^* = \frac{\delta_i}{1 - \sum \alpha_i} + \frac{\sum \theta_i}{1 - \sum \alpha_i} x^* \quad (7)$$

The equation can be written as:

$$z^{*} = \beta_0 + \beta_1 x_{it} \tag{8}$$

The standard error can be estimated as:

$$\zeta_{it} = z + z^{*} \tag{9}$$

It can be written as:

$$\zeta_{it} = z_{it} - \beta_0 - \beta_1 x_{it} \tag{10}$$

The estimates of β_0 and β_1 could be find from:

$$z_{it} = \delta_i + \sum_{i=1}^{q} \alpha_i z_{i,t-1} + \sum_{i=0}^{p} \theta_i x_{i,t-1} + \varepsilon_{it} \tag{11}$$

Then estimates are:

$$\beta_0 = \frac{\delta_i}{1 - \sum \alpha_i} \tag{12}$$

$$\beta_1 = \frac{\sum \theta_i}{1 - \sum \alpha_i} \tag{13}$$

Now, the ECM can be found from the following ARDL framework:

$$\Delta z_{it} = \delta_i + \sum_{i=1}^{q-1} \alpha_i \Delta z_{i,t-1} + \sum_{i=0}^{p-1} \theta_i \Delta x_{i,t-1} + \kappa_1 z_{i,t-1} + \kappa_2 x_{i,t-1} + \psi_{it} \tag{14}$$

Where, κ_1 is:

$$\kappa_1 = -(1 - \sum_{i=1}^{q} \theta_i) \tag{15}$$

κ_2 is:

$$\kappa_2 = \sum_{i=1}^{p} \theta_i \tag{16}$$

Long run estimates are as follows:

$$\beta_0 = \frac{1}{\kappa_1} \tag{17}$$

$$\beta_1 = -\frac{\kappa_2}{\kappa_1} \tag{18}$$

Now, to capture the short run results, ECM is as follows:

$$\Delta z_{it} = \delta_i + \sum_{i=1}^{q-1} \alpha_i \Delta z_{i,t-1} + \sum_{i=0}^{p-1} \theta_i \Delta x_{i,t-1} + \kappa_1 (z_{i,t-1} - \frac{1}{\kappa_1} - \frac{\kappa_2}{\kappa_1} x_{i,t-1}) + \psi_{it} \tag{19}$$

$$\Delta z_{it} = \delta_i + \sum_{i=1}^{q-1} \alpha_i \Delta z_{i,t-1} + \sum_{i=0}^{p-1} \theta_i \Delta x_{i,t-1} + o_i (z_{i,t-1} - \hat{\beta}_0 - \hat{\beta}_1 x_{i,t-1}) + \psi_{it} \tag{20}$$

$z_{i,t-1} - \hat{\beta}_0 - \hat{\beta}_1 x_{i,t-1}$ is defined as lagged error term, then:

$$\Delta z_{it} = \delta_i + \sum_{i=1}^{q-1} \alpha_i \Delta z_{i,t-1} + \sum_{i=0}^{p-1} \theta_i \Delta x_{i,t-1} + o_i \omega_{i,t-1} + \psi_{it} \tag{21}$$

o_i is a coefficient of adjustment.

In the case of MG estimators, ECM runs for each country separately and δ_i, o_i and β_i are calculated. Averages of δ_i, o_i and β_i are utilized to estimate MG parameters. That requires a long time for each cross section. Therefore, MG estimators are not very efficient for a relatively small time series observations. In case of PMG estimators, maximum likelihood estimators are used for

the homogeneity restriction. Therefore, long run coefficients remain same and PMG remains efficient even for small time series observations in a panel.

Hausman Test

To compare the efficiency and consistency of estimators calculated by MG and PMG, Hausman test is utilized. This test follows the χ^2-distribution. The test-statistic (H) is as follows:

$$H = (\hat{\beta}_{MG} - \hat{\beta}_{PMG})' \vartheta^{-1} (\hat{\beta}_{MG} - \hat{\beta}_{PMG}) \quad (22)$$

where,

$$\vartheta = Variance(\hat{\beta}_{MG}) - Variance(\hat{\beta}_{PMG}) \quad (23)$$

RESULTS AND INTERPRETATIONS

This study aims at testing the stability of MDF for a panel of GCC countries. Before regressing any model, the problem of unit root has been tested through Im et al. (2003) test, as most of macroeconomic series have unit root problem. After a confirmation of order of integration through a unit root test, the structural breaks have been estimated in the individual country's long run relations. Further, a single structural break for an individual country is estimated due to a specific reason that it cannot be counted the same for all countries as each country has been gone through different reforms at different points of time and can have different structural breaks in long run relationship. Therefore, after incorporating the effects of breaks in the model, the MG and PMG estimators have been estimated. The selection of these techniques has been done due to their superiority in case of a mix order of integration. Our model is showing a mix order of integration in table 1. Therefore, MG and PMG are better choice for estimation of a long run relationship in the MDF. After estimation of MG and PMG, the efficiency and consistency of estimated parameters have been tested by Hausman test to decide whether MG or PMG has better degree of efficiency and consistency in estimates. Lastly, the most important objective of this study has been verified through CUSUM and CUSUMsq tests to insure the stability of MDF.

Table (1) presents the Im et al. (2003) results on our selected variables in the MDF. LMD_{it} and LY_{it} have unit roots at their levels and are stationary at their first differences. Inflation rate is found stationary both at level and its first difference. Interest rate is non-stationary at level when we test it with only intercept and it is stationary when we test it with intercept and trend. Exchange rate is stationary when we test it with intercept only but non-stationary with both intercept and trend in analysis. Overall, a mix order of integration is found in MDF but this may give reason to move forward with these results as we are using the MG/PMG estimators that are the parameterization of ARDL model and these are efficient in the presence of a mix order of integration.

In the GCC countries, many financial reforms have been taken to improve the efficiency of financial markets. The financial crises in the global market are hit the financial market then GCC countries are no more exception to it in this volatile world. In the long time span of 1980-2014, there can be many structural breaks due to financial reforms and financial crises. But, these breaks are not happening at the same time in the all GCC countries. Because, each country's economy has its own unique features and monetary policy. Therefore, it is very pertinent to test the structural breaks in the individual country's long run relationship. The present study intends to incorporate the information of such breaks to avoid any biasness in the regression analysis without disturbing degree of freedom. Therefore, to keep both ends safe, the present study captures only

one most significant unknown structural break for each GCC country separately excluding known breaks like world financial crises.

Table 1
IPS TEST

VARIABLES	INTERCEPT	INTERCEPT AND TREND
LMD_{it}	9.2388 (0.9999)	1.8475 (0.9677)
ΔLMD_{it}	-3.7126 (0.0001)***	-4.7636 (0.0000)***
LY_{it}	6.4631 (0.9999)	-0.7885 (0.2152)
ΔLY_{it}	-6.3600 (0.0000)***	-6.6054 (0.0000)***
P_{it}	-4.2376 (0.0000)***	-3.4309 (0.0003)***
ΔP_{it}	-9.0112 (0.0000)***	-7.8541 (0.0000)***
R_{it}	-0.3484 (0.3638)	-3.3346 (0.0004)***
ΔR_{it}	-8.4423 (0.0000)***	-7.5770 (0.0000)***
ER_{it}	-1.7851 (0.0371)**	-0.5862 (0.2795)
ΔER_{it}	-8.1099 (0.0000)***	-7.5109 (0.0000)***

Note: Δ is first difference. ( ) contain the p-values of test statistic. *** shows rejection of null hypothesis at 1% level and ** shows at 5% level.

Table 2
BAI AND PERRON STRUCTURAL BREAK TEST

Sr. No.	COUNTRY	STRUCTURAL BREAK
1	Kingdom of Saudi Arabia	1986
2	Bahrain	2003
3	Kuwait	1994
4	Oman	2007
5	Qatar	2001
6	United Arab Emirate	1991

Table (2) shows the results of Bai and Perron structural beak test with 0.15 trimming and at 5% level of significance. The most significant breaks in 1986, 2003, 1994, 2007 and 2001 are found for Saudi Arabia, Bahrain, Kuwait, Oman, Qatar and UAE respectively. The structural break of Oman is only matching with world financial crises and rest of countries have different most significant breaks. These break point may disturb the parameters of money demand function.

Therefore, we use a dummy variable in the regression analysis to incorporate the impact of these breaks in the MDF.

In table (3), the regression results based on PMG estimators are presented. Analyses have been done with and without dummy variable of structural break in the regression. At first, both MG and PMG estimators have been calculated and Hausman test has been employed to verify the efficiency and consistency of coefficients. The test statistic of Hausman test has remained very low and its p-value has been observed very high. Therefore, PMG estimators are more reliable to elaborate and to present here.

Table 3
RESULTS OF PMG ESTIMATORS

VARIABLES	MODEL 1 WITHOUT DUMMY	MODEL 2 WITH DUMMY
LONG-RUN COEFFICIENTS		
LY_{it}	1.2079 (0.000)***	1.1439 (0.000)***
R_{it}	-0.0054 (0.0856)*	-0.0061 (0.0764)*
P_{it}	-0.0041 (0.131)	-0.0041 (0.087)*
ER_{it}	0.4317 (0.012)**	0.3863 (0.018)**
Dummy	--	0.226 (0.000)***
ERROR-CORRECTION TERM		
ECT_{t-1}	-0.2765 (0.001)***	-0.3079 (0.001)***
SHORT-RUN COEFFICIENTS		
LY_{it}	0.3056 (0.000)***	0.2957 (0.000)***
R_{it}	-0.0034 (0.457)	-0.0028 (0.533)
P_{it}	0.0002 (0.862)	0.0010 (0.260)
ER_{it}	-2.1345 (0.288)	-2.0977 (0.297)
Intercept	-0.9369 (0.002)***	-0.8589 (0.001)***
Hausman Test	0.4600 (0.4983)	0.4400 (0.5070)

Note: Parenthesis contains the p-values test statistic. ***,** and * shows the level of significance at 1%, 5% and 10% respectively.

Table (3) represents the results of PMG estimators with and without dummy variable in model 2 & 1 respectively. The coefficient of dummy variable has remained positive and significant. This shows an intercept shift in money demand model after the break point of each

country in the analysis. Further, income has a positive and significant effect with income elasticity more than one in both model 1 & 2. High elasticity indicates that in the time of economic growth, money will be demand more than income growth rate. Interest rate exhibits negative but weakly significant effect. A negative interest and positive income effects are aligned with the standard theory of money demand. The coefficient of exchange rate has been observed positive and significant. It is aligned with the wealth effect hypothesis. This states that a depreciation of local currency motivates the people to demand more local currency due to increment in value of foreign asset's holding in terms of the local currency. In model 1, the impact of inflation remains negative and insignificant. But, inflation rate has a negatively significant effect at 10% level of significance in the model 2. An increase in inflation reduces the value of local currency and people tend to add other asset in their portfolio to save their purchasing power. Further, the present study checks the CUSUM and CUSUM square tests to ensure the stability of MDF with incorporation of the dummy variable in the function. The figures (2a & 2b) are showing that MDF is stable. In the short run analysis, the most of regressors are showing insignificant behavior except income variable. Income is positively and significantly impacting on money demand in the both models. But income elasticity is found less than one.

Figure 2a
CUSUM TEST

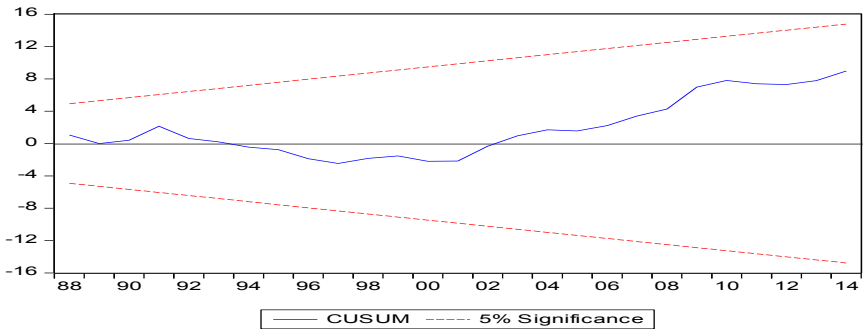
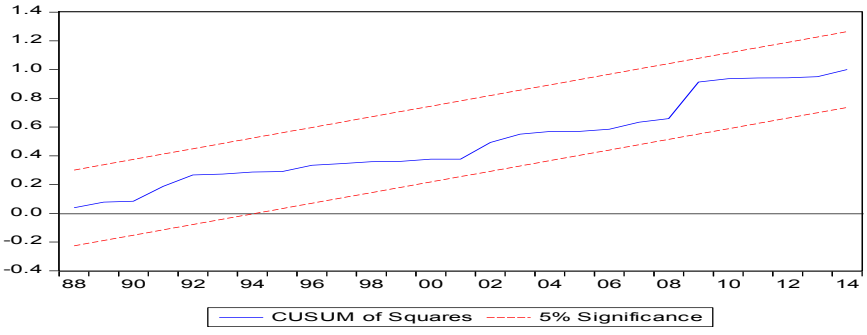


Figure 2b
CUSUMSQ TEST



CONCLUSION

The stability of MDF is prerequisite for the monetary policy in any country. This research has investigated the most important determinants of money demand and also tests its stability by

using a period of 1980-2014 for GCC countries. A mix order of integration has been found in the unit root analysis. The long run results indicate that income has a positive effect on money demand with an elasticity greater than unity. Exchange rate is positively determining the money demand. Inflation and interest rates have the negative effects on money demand with very small coefficients. In the short run analysis, income is only determinant of money demand with elasticity less than unity. Lastly, MDF has been proved stable. Therefore, this study suggests money supply as a valid monetary policy instrument for GCC countries.

REFERENCES

Akinkunmi, M.A. (2004). *Money demand in developing countries: a dynamic panel approach*. ETD Collection for Fordham University. Paper AAI3125001.

Bahmani-Oskooee, M. & A. Gelan (2009). How stable is the demand for money in African countries? *Journal of Economic Studies,* 36, 216-235.

Bahmani-Oskooee, M. & H. Rehman (2005). Stability of the money demand function in Asian developing countries. *Applied Economics*, *37*(7), 773-792.

Bai J. & P. Perron (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18(1), 1-22.

Carrera, C. (2012). *Long-run money demand in Latin-American countries: A nonstationary panel data approach*. Working Paper, Banco Central de Reserva del Perú.

Dreger, C., H.E. Reimers & B. Roffia (2007). Long-run money demand in the new EU member states with exchange rate effects. *Eastern European Economics*, *45*(2), 75-94.

Goldfeld, S.M. (1994). *Demand for Money: Empirical Studies*. In the New Palgrave Dictionary of Money and Finance. Edited by P. Newman, M. Milgrate & J. Eatwell. London: Macmillan Press.

Hamdi, H., A. Said & R. Sbia (2015). Empirical evidence on the long-run money demand function in the Gulf Cooperation Council countries. *International Journal of Economics and Financial Issues,* 5(2), 603-612.

Im, K.S., M.H. Pesaran & Y. Shin (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53-74.

Kumar, S., M. Chowdhury & B.B. Rao (2013). Demand for money in the selected OECD countries: a time series panel data approach and structural breaks. *Applied Economics*, 45(14), 1767-1776.

Mahmood, H. & M. Asif (2016). An Empirical Investigation of Stability of Money Demand for GCC Countries. *International Journal of Economics and Business Research*, 11(3), 274-286.

Mark, N.C. & D. Sul (2003). Cointegration Vector Estimation by Panel DOLS and Long-run Money Demand. *Oxford Bulletin of Economics and Statistics*, 65(5), 655-680.

Narayan, P.K., S. Narayan & V. Mishra (2009). Estimating money demand functions for South Asian countries. *Empirical Economics,* 36, 685-696.

Pesaran, M.H., Y. Shin & R. Smith (1999). Pooled Mean Group Estimator of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94, 621-634.

Poole, W. (1970). Optimal choice of monetary policy instruments in a simple stochastic macro model. *The Quarterly Journal of Economics*, 84(2), 197-216.

Rao, B.B., A. Tamazian & P. Singh (2009). *Demand for money in the Asian countries: a systems GMM panel data approach and structural breaks.* MPRA Paper No. 15030.

TECHNOLOGICAL CHANGE AND JOB POLARIZATION: THE WISCONSIN EXPERIENCE

Erika S. Rattunde, University of Wisconsin
Jerome Segura III, University of Wisconsin
Scott Wallace, University of Wisconsin

ABSTRACT

This analysis examines the impact of automation on the composition of occupational employment for the United States, Wisconsin and Central Wisconsin. Specifically, we analyze how computer-based technologies and robotics have contributed to job polarization by reducing the number of "middle-skilled" jobs while bolstering employment in both low-and-high skilled jobs.

INTRODUCTION

Automation is defined as "the use of largely automatic equipment in a system of manufacturing or other production process" (Google.com, 2015). Automation, by definition, implies a changing role for human beings in the production process. This paper summarizes the impact of automation on the composition of occupational employment in the United States over the last three decades and extends the analysis to the state of Wisconsin. In doing so, we build on the work of David Autor and others in assessing automation's impacts (Autor, 2015; Autor, 2014: Autor & Dorn, 2013). Automation over this period consisted largely of computer-based information and communication technologies (ICT) and robotics. Investments in these technologies have increased significantly over the last half-century. "The share of information processing equipment and software in private, non-residential investment rose from approximately 8 percent to more than 30 percent between 1950 and 2012, with the largest leap occurring between 1990 and 2000" (Autor, 2014, 1). We begin by looking at the historical record in assessing the effects of automation on aggregate employment. Next, we examine how automation has contributed to job polarization in the United States over the last thirty-five years. Specifically, automation has reduced the number of "middle skill" jobs while bolstering the number of both low- and high-skilled jobs. Then we compare and contrast the evolving labor sheds in both Wisconsin and Central Wisconsin to national trends. Lastly, we conclude with a discussion about the societal challenges and policy implications posed by automation of the manufacturing sector.

AUTOMATION AND TECHNOLOGICAL UNEMPLOYMENT

In describing the economic effects of automation on the labor force, social commentators tend to focus on how technologies take over tasks traditionally performed by workers. While the adoption of these devices displaces certain kinds of workers, understanding their impact on aggregate employment requires a more robust economic analysis. Economic historians have shown that, in prior eras, automation has contributed to long-term increases in employment and higher standards of living. Here, we take a brief look at the historical experience of the textile industry during the British industrial revolution in the 19th century.

Innovations such as the power loom and spinning jenny in the 18th century transformed the production of textiles, ultimately leading to the relocation of production from households to factories. By doing tasks normally done by weavers, the power loom effectively reduced 98 percent of the labor needed in weaving a yard of cloth (Bessen, 2015). The "invention of the power loom in 1787 increased productivity over the hand loom not only because it could weave faster (by the mid-1820s, at any rate) but because a single person, who was no longer providing the motive power, could operate more than one loom" (Langlois, 2003, 175). The Luddites, a group of handloom weavers, famously destroyed a number of these machines to protest the increased use of the power loom.

While Karl Marx focused on the dislocation of weavers and spinners during this period, he failed to appreciate the impact of automation on the demand for other activities connected with the production of cloth. While automation substitutes for work performed by some laborers, it simultaneously complements the skills of others. The introduction of the power loom and spinning jenny, for example, spurred an increase in the demand for labor, particularly for "mechanics to fix new machines . . . supervisors to oversee the new factory system and accountants to manage enterprises operating on an unprecedented scale" (Mokyr et al., 2015, 36). In addition, automation led to labor shortages of highly skilled workers needed to operate these new machines. Workers responsible for tending the power loom, for example, performed a greater number of tasks than workers operating handlooms (Langlois, 2003, 175). In the event that newly created occupations are novel and more complex, then labor markets will likely lack the appropriately skilled workers required to fill these positions. This certainly was true when power looms were initially introduced in the 1800s (Bessen, 2015, 19).

Economic historians also have identified a number of secondary effects of technological innovation on employment. The productivity gains in the production of textiles ultimately translated into lower cloth prices for consumers. The increase in purchasing power attributed to lower prices allowed consumers to purchase, among other products, more clothes, and subsequently bolstered employment not only in the textile industry but also in the aggregate economy (Bessen, 2015). Machine shops that initially specialized in the production and repair of textile equipment eventually evolved into a machine tool sector that further supported growth in other emerging industries like firearms, locomotives, farm machinery, and sewing machines (Rosenberg, 1963). "[T]echnological progress also took the form of product innovation and thus created entirely new sectors for the economy…"(Mokyr, et al., 2015, 36).

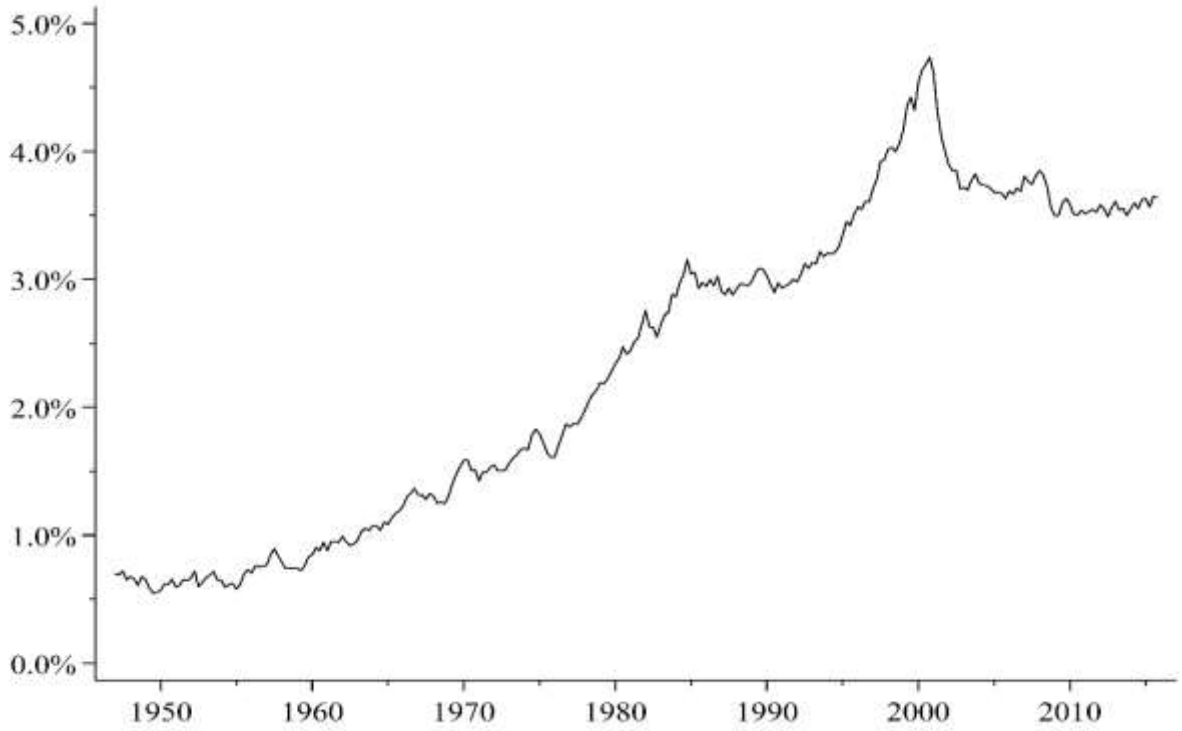
The belief that technological progress leads to a reduction in aggregate employment is known to economists as the "lump of labor" fallacy. This kind of thinking presumes that the amount of work is fixed and therefore, in terms of its effect on employment, technological progress is essentially a zero sum game (Autor, 2014, 2). In this sense it is important to remember that we live in a dynamic and innovative society wherein many of today's products (smartphones, electric cars, & Facebook) and jobs (mobile app developer, social media manager, admissions consultant, & market researcher data miner) simply did not exist fifteen years ago (Casserly, 2012).

AUTOMATION AND LABOR MARKET POLARIZATION

In this section, we evaluate the impact of technological investments on occupational employment. As shown in **Figure 1**, the amount of investment in information technologies and

software (as measured as the percent of GDP) dramatically increased during the last half of twentieth century, peaking at the height of the dot.com bubble in 2000.

Figure 1
PRIVATE FIXED INVESTMENT IN INFORMATION PROCESSING EQUIPMENT AND SOFTWARE/GROSS DOMESTIC PRODUCT, 1947-2014



However, history indicates that automation has not reduced overall employment, but rather, by substituting for some workers' tasks and by complementing other workers' tasks, it has altered the composition of employment. In evaluating the changing division of work between machines and humans, it is important "to understand the different cognitive structures of humans and machines (including computers)" (Langlois, 2003, 167). Humans have a comparative advantage over machines in the "exercise of judgment in situations of ambiguity and surprise to more mundane abilities in spatio-temporal perception and locomotion." (Langlois, 2003, 167). Advances in computers and robotics have led to the creation of machines that have a comparative advantage in completing explicit and well-defined, sequential tasks. In other words, computers excel at following rules or algorithms. Economist David Autor describes the combined effects of these comparative advantages on labor markets.

Human tasks that have proved most amenable to computerization are those that follow explicit, codifiable procedures - such as multiplication - where computers now vastly exceed human labor in speed, quality, accuracy, and cost efficiencies. Tasks that have proved most vexing to automate are those that demand flexibility, judgment, and common sense - skills that we understand only tacitly - for example developing a hypothesis or organizing a closet. The interplay between machine and human comparative advantage allows computers to substitute for workers in performing routine, codifiable tasks while amplifying the comparative advantage of

workers in supplying problem solving skills, adaptability, and creativity. Understanding the interplay is central to interpreting and forecasting the changing structure of employment in the U.S. and other industrialized countries (Autor, 2014, 1).

In empirically testing the effects of automation on the occupational structure of the US labor market, David Autor (2015) uses Census data in tracking the percent change in employment for ten major occupational categories by decade. In contrast to the levels approach of Autor (2015), we pursue a labor share analysis. Let E_{ijt} be jurisdiction j's employment in occupation at time t, and $\sum$ is jurisdiction j's total employment at time t. Thus, $\frac{}{\sum}$ reflects occupation i's labor share in jurisdiction j at time t. Suppose growth in the occupational share of labor over interval n occurs at rate r such that

$$\left[\frac{}{\sum}\right] \qquad \left[\frac{it}{\sum_i E_{it}}\right]. \tag{1}$$

Rearranging Equation (1) and taking the log yields

$$\{l\ g[E \quad] \quad g[E_{it}]\} \qquad \{l\ g[\sum \quad] \quad g[\sum \quad]\} \quad 100. \tag{2}$$

Equation (2) indicates that the growth rate in occupation i's share of total employment is interpreted as jurisdiction j's growth in employment in occupation i net jurisdiction j's total employment growth.

The data used in this study are collected from IPUMS-USA (Ruggles, et al., 2015). The data set includes the 1980 5% state sample, the 1990 5% state sample, the 2000 5% sample, the American Community Survey 2005-2007 3-year sample, and the American Community Survey 2012 sample. This analysis focuses on the subpopulation of employed people with age ranging from 16 through 64 years. Occupations are defined by the 1990 Census Bureau occupational classification codes. Moreover, the estimates in this analysis are derived through the use of IPUM's syntax for subpopulation analysis. In other words, this approach produces estimates for each occupational category in every period while accounting for the sample design.

IN

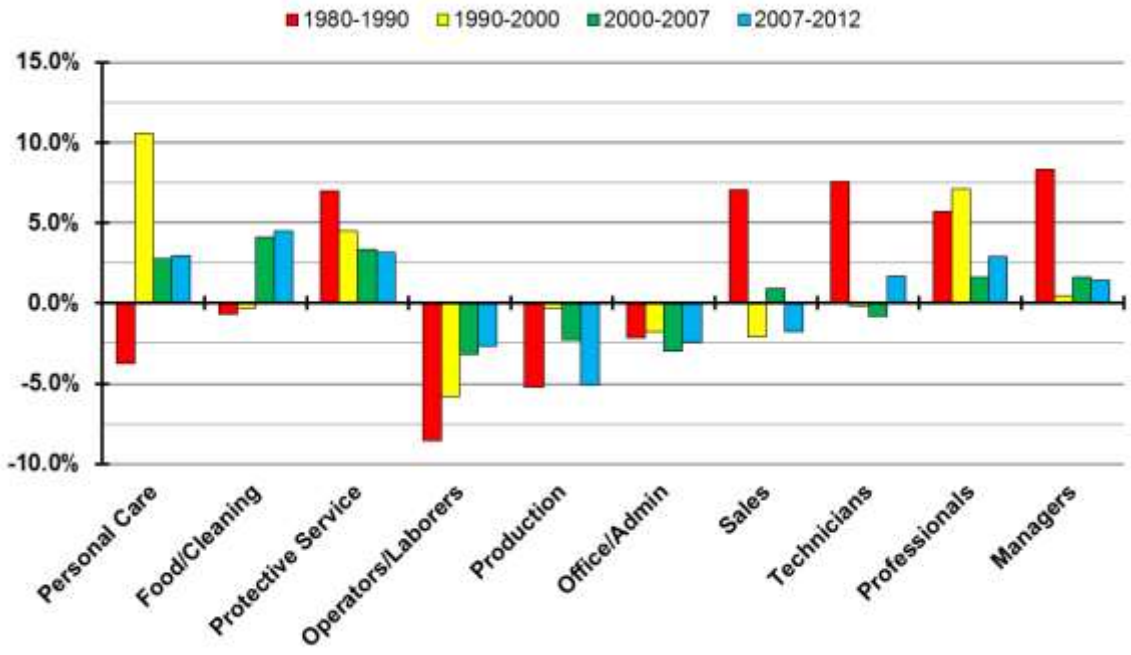
Figure 2, The ten occupational groups are located on the horizontal axis with low-skilled occupations on the left (personal care, food/cleaning, protective services), middle-skilled occupations (operators/laborers, production, office/administrative, & sales) in the middle, and high-skilled occupations on the right (technicians, professionals, & managers). the vertical axis shows the percent change in employment for each occupational group as a share of total employment for the periods 1979-89, 1989-99, 1999-2007, and 2007-12.

Figure 2 indicates that "the rapid employment growth in both high- and low-education jobs has substantially reduced the share of employment accounted for by 'middle-skill' jobs. In 1979, the four middle-skilled occupations accounted for 60 percent of employment. In 2007, this number was 49 percent, and in 2012, it was 46 percent" (Autor, 2015, 14). Other industrialized nations also experienced a similar degree of job polarization over the period.

The growth of both high- and low-skilled jobs combined with the relative decline of middle-skilled jobs reflects the disparate impact of automation on employment. Low-skilled manual jobs that comprise food preparation, cleaning services, security guards, and personal care occupations require "situational adaptability, visual, and language recognition, and in-person

interactions" and are therefore hard to automate (Autor, 2015, 12). Technicians, professionals and managers are high-skilled occupations that require communication skills, creativity, critical reasoning, and problem-solving capabilities. The abstract tasks required in these occupations are, thus far, difficult to automate.

Figure 2
PERCENT CHANGE IN LABOR SHARE BY OCCUPATION, US



As the costs of computing have declined over time, information and communication technologies increasingly have been substituted for labor in "performing routine tasks – such as bookkeeping, clerical work, and repetitive production and monitoring activities – which are readily computerized because they follow precise, well-defined procedures in the middle of the occupation skill and wage distribution" (Autor and Dorn, 2013, 1559). As shown in the previous chart, these middle-skilled occupations faced relative declines in employment over the last thirty-five years.

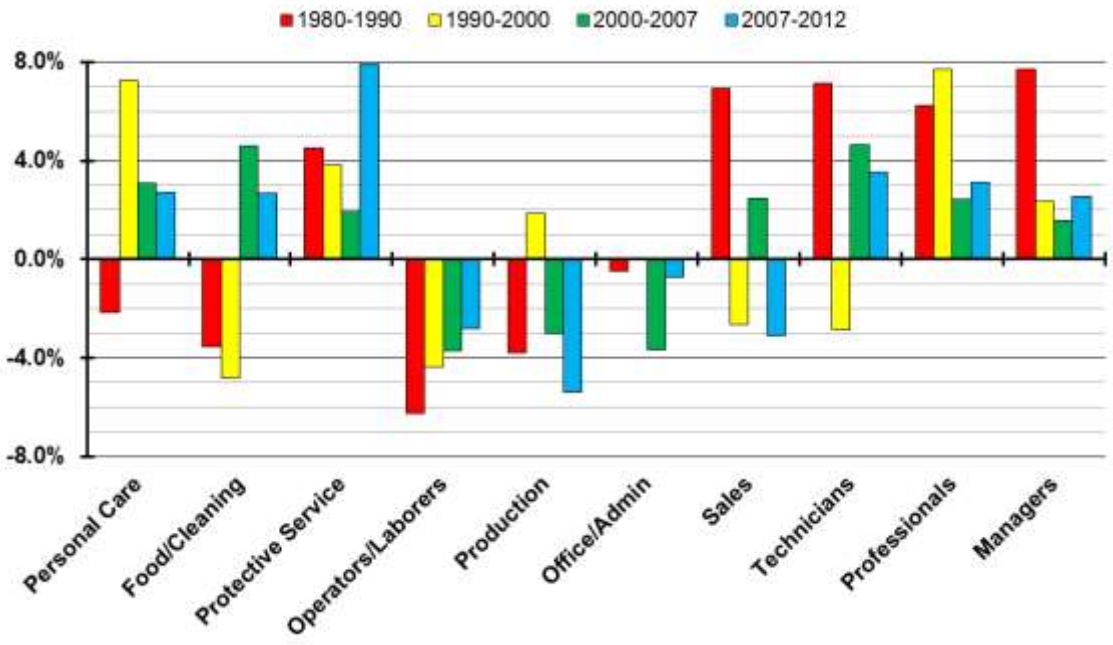
Information technology complemented workers who perform abstract tasks thereby increasing the growth of high-skill jobs, especially between 1979 and 1999. "By dramatically lowering the cost and increasing the scope of information and analysis available to them, computerization enables workers performing abstract tasks to further specialize in their area of comparative advantage, with less time spent on acquiring and crunching information, and more time spent on interpreting and applying it" (Autor, 2015, 15). These complementarities, however, were not responsible for the significant growth of low-skill, labor-intensive jobs whose share of total labor hours increased by 30 percent between 1980 and 2005. Computer-based technologies have had little impact, positive or negative, on the tasks associated with these kinds of positions. The growth in low-skill jobs is largely attributed to displaced workers moving from middle-income manufacturing to low-income service occupations. The manual tasks of service occupations require a high degree of physical flexibility and are therefore less amenable to computerization (Autor and Dorn, 2013).

Figure 2 above shows that the growth in high-skilled positions fell dramatically since 2000. MIT economist, David Autor, largely attributes this slowdown to the parallel decline in investment in computer technologies following the bursting of the dot.com bubble in 2000 and the financial crisis in 2008. Autor also points to rapid globalization and the emergence of China's manufacturing sector as economic factors that have contributed to job polarization, recognizing that advances in automation and information technologies have made it easier for firms to outsource production to other nations (Autor, 2015, 22).

THE WISCONSIN EXPERIENCE

In contrast to the previous section, we now evaluate the impact of automation on relative changes in occupational employment measured as a share of total nonagricultural employment in the state of Wisconsin. Within a region, the occupational share of employment equals the ratio of the job count in a specific occupation to the aggregate number of jobs. In other words, our approach studies the occupational mix of the Wisconsin and Central Wisconsin labor sheds while internalizing the random fluctuations in the size of the labor sheds. The occupational employment procedures are otherwise identical to Autor (2015).

Figure 3
PERCENT CHANGE IN LABOR SHARE BY OCCUPATION, WISCONSIN



Error! Reference source not found. plots the percent change in the occupational shares of total non-farm employment approximated by the log difference times 100. Again, this is a method to estimate percentage changes. The three left columns are low-skill and low-pay occupations whereas the right three columns are the high-skill and high-pay occupations. Lastly, the middle four columns are middle-skill and subsequently middle-pay jobs. **Error! Reference**

source not found. illustrates a pattern, similar to the national trend, of labor market polarization for the state of Wisconsin.

In evaluating the scope of labor market polarization, our analysis now shifts its focus to the employment situation in Central Wisconsin. The Central Wisconsin region includes the following counties: most notably Portage, Marathon, and Wood as well as Juneau and Adams to the south and Forest, Langlade, Lincoln, Oneida, and Vilas to the north. The construction of **Figure 3** is identical to **Error! Reference source not found.**.

Figure 3
PERCENT CHANGE IN LABOR SHARE BY OCCUPATION, CENTRAL WISCONSIN

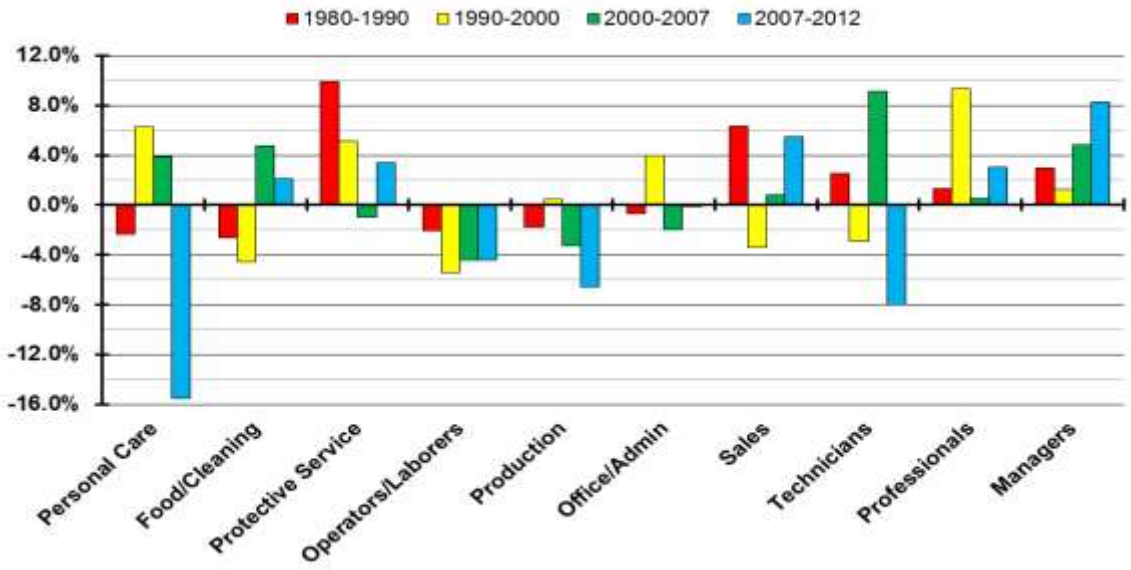


Figure 3 continues to depict a pattern of labor market polarization in Central Wisconsin that is similar to the state and national trends. However, the growth rates appear to be increasingly volatile as the geographic scope of the analysis narrows. This is consistent with the notion that local market outcomes are, perhaps, more sensitive to randomness attributed to factors such as industry mix, public policy, and the regional economic environment.

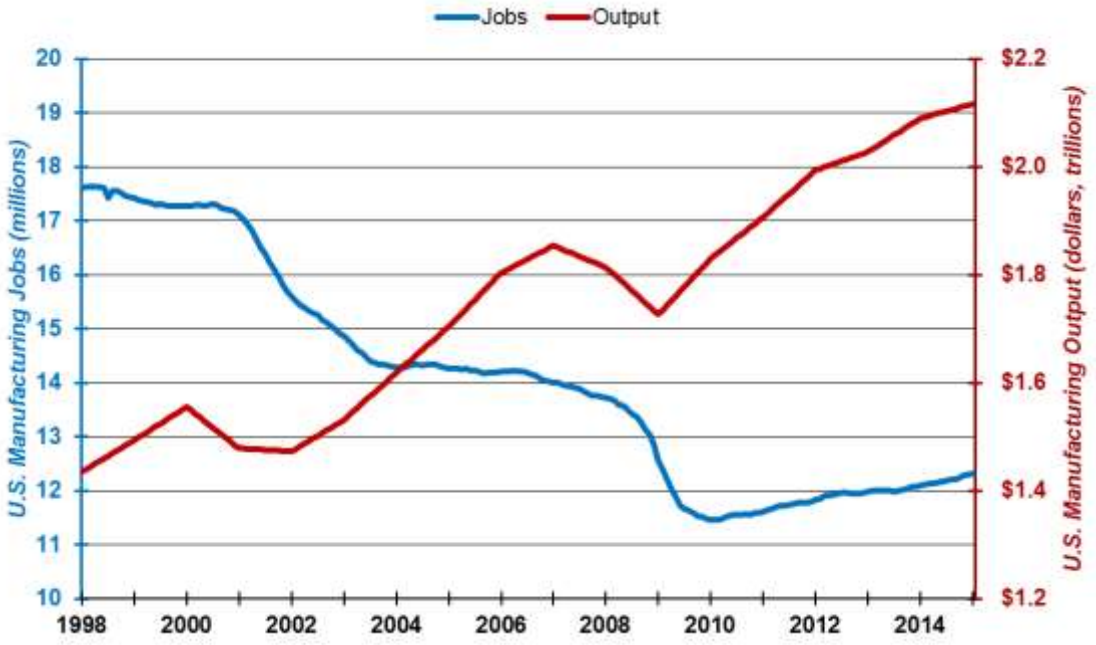
In summary, both **Error! Reference source not found.** and **Figure 3** suggest the share of middle-skill jobs is contracting while the low-skill and high-skill occupations account for larger shares of those employed. The most striking difference between the experiences in Wisconsin and Central Wisconsin relative to the national trend is significant reduction in certain occupations related to the manufacturing sector such as Operators, Laborers, and Production. This significant change in the composition of the state and regional employment base is almost certainly tied to the initial high concentration of manufacturing in the region relative to the national average.

AUTOMATION AND EMPLOYMENT IN THE MANUFACTURING SECTOR

Perhaps no sector of the economy better illustrates the impact of automation on employment than the manufacturing sector. **Figure 4** shows the number of manufacturing jobs and the dollar value of manufacturing output in the United States from 1998 to 2014. The output data is from the *U.S. Bureau of Economic analysis*; the employment data is from the *United States*

Bureau of Labor Statistics. Despite manufacturing jobs declining by about a third over that time period, output increased in value from 12.5 to 19.0 trillion dollars. The productivity gains from automation mean that a lot more output can be produced with far fewer workers. The above graph clearly demonstrates how automation substitutes for the tasks of some production workers.

Figure 4
MANUFACTURING JOBS VERSUS OUTPUT, US

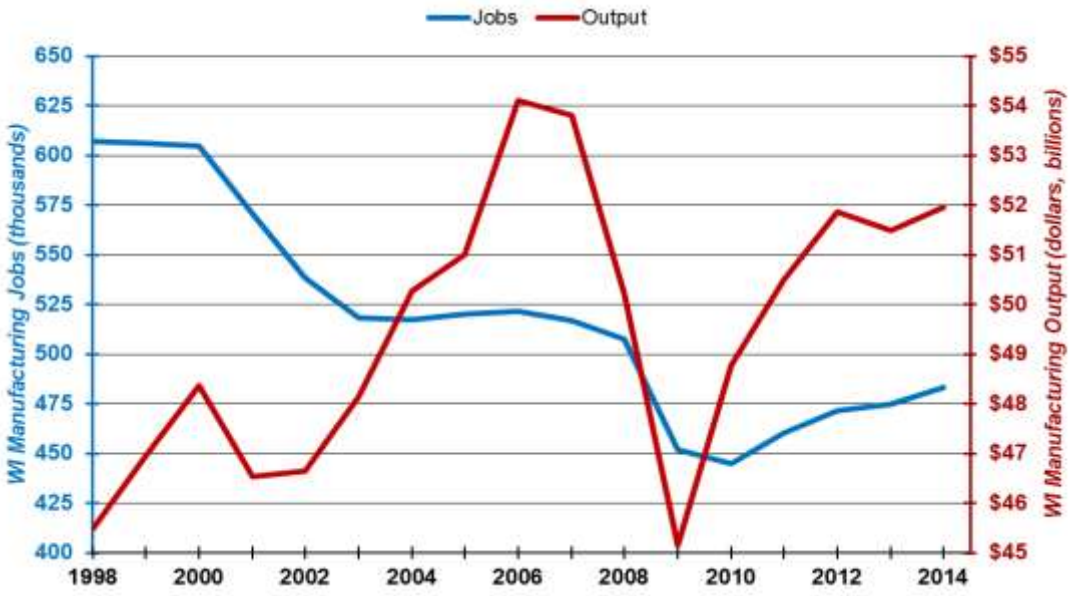


Another statistic reveals the impact of automation on the changing nature of work in manufacturing. According to Manpower, there were approximately 600,000 unfilled US manufacturing jobs in 2013. "Most of these jobs are for skilled production workers in roles like machinists, craft workers, distributors and technicians. These jobs require extensive training and are difficult to fill" (Davenport, 2013, 2). The high number of unfilled jobs demonstrates how automation can increase the demand for skilled workers who complement these new technologies.

In Wisconsin, the manufacturing sector employs more people than any other sector. Wisconsin "is home to 9,400 manufacturers employing over 450,000 workers, which is nearly 17% of the state's workforce" (Schmid, 2014). Drawing on data from U.S. Bureau of Economic Analysis, **Figure 5** below shows the number of jobs and manufacturing output from 1998 to 2014 for the state of Wisconsin. Like the nation, the state has experienced a dramatic decline in the number of manufacturing jobs, though there has been a modest rebound since 2010. Except for the sharp decline in output during the great recession, manufacturing output has continued to rise despite the decrease in the number of workers.

Wisconsin manufacturers similarly have had difficulty finding qualified people to fill vacancies for high-skilled positions. For 2013, Wisconsin manufacturers "posted 891 openings for mechanical engineers . . . compared to 780 openings for software developers" (Schmid, 2013).

Figure 5
MANUFACTURING JOBS VERSUS OUTPUT, WI



The confluence of technological unemployment and job vacancies in the manufacturing sector poses challenges for policymakers in addressing skill mismatches. As David Autor has observed, "human capital investment must be at the heart of any long-term strategy for producing skills that are complemented by rather than substituted for technological change" (Autor, 2015, 27). Time is a major obstacle to meeting the new skill needs. There is often a significant lag between the introduction of a new technology and its widespread application. Economist James Bessen explains that "[i]t takes time for technical knowledge to be developed, longer for it to spread, and even longer for institutions to emerged, such as labor markets that allow ordinary workers to benefit from their knowledge. Such learning on a mass scale was and is a difficult problem for society" (2015, 18).

In the manufacturing sector, new technologies like computer-aided design and manufacturing (CAD/CAM), computer numerical control (CNC), and robotics are highly complex. Workers require significant amounts of training before they are able to use these technologies (Davenport, 2013a). The skills are often highly specific to a particular industry (or firm). The lack of standardization across industries has slowed the development of educational institutions that can provide comprehensive training. Businesses have taken a more fragmented approach, relying on "a combination of publicly available education (typically in community colleges or technical schools), vendor-based education and on-the-job training" (Davenport, 2013b, 2-3).

The lack of appropriate training opportunities at the technical and community college levels has forced businesses to be creative in developing their own training programs. In the Houston area, a business association backed by like Exxon, Mobil, Shell, and Chevron Phillips is training local workers technical skills for local jobs in the oil industry. Dow Chemical has implemented an apprenticeship program to train workers to run its facilities. The program costs Dow a $100,000 a participant. Over 100 firms along the Ohio-Pennsylvania border established

the Oh-Penn Manufacturing Collaborative which sponsors training programs for jobs in the area's machine-building industry (Campoy, 2015). Private efforts in addressing skilled labor shortages are often necessary given the obstacles in creating training programs on a mass scale.

In Manpower's report, The Future of the Manufacturing Workforce, Tom Davenport describes several policy proposals designed to help fill the skills gap in manufacturing.

- Institutionalized Funding at Many Levels: "Federal funding, whether in the U.S. or Canada, is not going to meet all needs for manufacturing-oriented education. There will have to be locally-driven stable funding for community and junior colleges and specific manufacturing programs within them if these institutions are to turn out the requisite number of trained students (Davenport, 2013c, 2-3).
- A Greater Degree of Sharing and Coordination: Manufacturing "education programs need a better ability to share and coordinate their content - not only with each other, but vendors of manufacturing technology and the companies that apply it" (Davenport, 2013c, 3). A clearinghouse that can centralize content used in instruction would facilitate the diffusion of knowledge and help expand the number of qualified faculty.
- Certification Programs: In addition to established programs for plumbers and electricians, there is a need for the ability to certify the skills of workers in other areas. These include "personal effectiveness competencies (showing up on time, working in teams), academic competencies (reading, writing, math), manufacturing competencies (safety, quality management) and industry-wide technical competencies (welding, machining, CNC)" (Davenport, 2013c. 3). The goal is to have community colleges and technical schools house these programs in the near future.

CONCLUSION

The current pace and scope of technological change implies a need for workers at all skill levels to update their skills throughout their working years. Unfortunately, the United States badly trails other developed economies in providing opportunities for job retraining. The United States "spends barely more than 0.1% of GDP on 'active labor market policies' to get the less skilled back to work, one-fifth of the OECD average" (The Economist, 2012, 24). As described in the previous section, greater support for technical and community colleges that possess specialized knowledge of the needs of local businesses can help provide workers with the appropriate training to meet those needs. As the capabilities of machines encroach on more abstract tasks, higher-skilled workers may find the need to update their skills as well. Economists Raghuram Rajan and Luigi Zingales believe that we "need more modular degrees and lifelong admission to a university (at least for the general programs) - so that the student can pick and choose what she wants and when she needs it" (Rajan and Zingales, 2003, 304).

The United States in the past has shown the willingness to make the necessary public investments to address skill shortages resulting from technological change. David Autor describes how our country responded to the human capital challenges of industrialization.

In 1900, the typical young, native-born American had only a common school education, about the equivalent of sixth to eighth grades. By the late 19th century many Americans realized that this level of schooling was inadequate: farm employment was declining, industry was rising, and their children would need additional skills to earn a living. The United States responded to the challenge over the first four decades of the 20th century by becoming the first nation in the world to deliver universal high school education to its citizens. Tellingly the high school movement was led by the farm states. Societal adjustments to earlier waves of technological

development were neither rapid, automatic, nor cheap. But they did pay off handsomely (Autor, 2015, 27). The challenges Central Wisconsin, Wisconsin, and the United States face today call for a similar kind of commitment to ensure the economic well-being of our fellow citizens.

REFERENCES

Autor D (2015) Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives*, Summer, 29(3), 3-30.

_____ (2014) Polanyi's Paradox and the Shape of Employment Growth, *NBER Working Paper, No. 20485*, September, 1- 46.

Autor D and Dorn D (2013) The Growth of Low-Skilled Service Jobs and the Polarization of the US Labor Market. *American Economic Review*, 103(5),1553-1597.

Bessen J (2015) Learning by Doing: The Real Connection between Innovation, Wages, and Wealth. New Haven: Yale University Press.

Campoy A (2015) Match Game: Companies Push Training to Close Skills Gap. April, 23. Wall Street Journal. Retrieved on 9/11/2015 from http://www.wsj.com/articles/match-game-companies-push-training-to-close-skills-gap-142.html

Casserly M (2012) 10 Jobs that Didn't Exist 10 Years Ago. May 11, Retrieved on 10/19/15 From http://wwwforbes.com/sites/meghancasserly/2012/05/11/10-jobs-that-didn't-exist-years-ago

Davenport T (2013a) Report One: Technology and the Manufacturing Workforce: An Overview from *The Future of the Manufacturing Workforce*, Manpower.

_____(2013b) Report Two: The Rise of the "Tech" in Manufacturing from *The Future of Manufacturing Workforce*, Manpower.

_____ (2013c) Report Five: Policy Prescriptions for the Manufacturing Talent Gap from. *The Future of Manufacturing Workforce*, Manpower.

Google (2015) Definition of Automation. Retrieved on 10/23/ 15 from http://www.google.com/webhp?sourceid=chromeinstant&ion=1&espv=2&ie=UTF-8

Langlois RN (2003) Cognitive comparative advantage and the organization of work: Lessons From Herbert Simon's vision of the future. *Journal of Economic Psychology*, 24,167-187.

Mokyr J, Vickers C and N Ziebarth (2015) The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different? *Journal of Economic Perspectives*, Summer, 29(3), 31-50.

Rajan R and Zingales L (2003) Saving Capitalism from the Capitalists. USA: Crown Business Press

Rosenberg N (1963) Technological Change in the Machine Tool Industry, 1840-1910. *Journal of Economic History*, 23(4), 414-443.

Ruggles S, K Genadek, R Goeken, J Grover & M Sobek (2015) Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]. Minneapolis: University of Minnesota.

Schmid J (2014) Report Highlights State's Stable Reliance on Manufacturing Jobs. Milwaukee Journal Sentinel, July 31. Retrieved on 11/1/2015 from http://www.jsonline.com/business/report-highlights-states-stable-reliance-on-manufacturing-jobs.html

_____ (2013) State's Manufacturing Economy is Changing. *Milwaukee Journal Sentinel*, December 7. Retrieved on 12/9/13 from http://www.jsonline.com/business/states-manufacturing-economy-is-changing-b99154473z1-234921941.html.