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# PREFACE

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*Being a recent product of the highly successful events organized by the Forum, this publication brings together the proceedings of the Business Cycles and the Global Crisis Conference held on May 25, 2010 in Istanbul.*

*April 2011*

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He has held visiting and permanent appointments at a number of universities around the world including the University of Oxford, the University of Rochester, Princeton University, Yale University, Johns Hopkins University, the University of California at Los Angeles and the University of New South Wales. During 1995-2000 he was a member of the Board of Directors of the Reserve Bank of Australia. He has consulted with a number of central banks about the design of macro-econometric models for monetary policy, including the Bank of England, the European Central Bank and the Norges Bank.

# Contents

# "İktisadi Dalgalanmalar ve Küresel Kriz" Konferansı Açılış Konuşması

**Ümit Boyner***

(*) TÜSİAD Yönetim Kurulu Başkanı

Sayın Bakanım, TÜSİAD'ın Değerli Üyeleri, Saygıdeğer Katılımcılar, Değerli Basın Mensupları,

TÜSİAD Yönetim Kurulu adına hepinizi saygı ile selamlıyorum. TÜSİAD-EAF işbirliği ile hazırlanan "İktisadi Dalgalanmalar ve Küresel Kriz" başlıklı konferansımıza hoş geldiniz.

Değerli Katılımcılar,

Hepinizin bildiği gibi, 2007 yılında Amerikan konut piyasasında patlak veren sorunlar, tüm dünyada ciddi bir durgunluğa yol açtı. Üstelik krizin boyutu tahminlerin çok üzerindeydi. Sayın Adrian Pagan'ın konuşması bize krizleri anlamak ve tahmin etmek konusunda çok büyük ufuklar açacak.

2008 yılı sonlarına doğru diğer gelişmiş ve gelişmekte olan ülke finansal piyasalarında da hissedilmeye başlamıştı. Krizin etkileri 2009 yılında ciddi ölçüde hissedildi, birçok ülke ekonomisi önemli ölçüde daraldı, köklü finans kurumlarının güvenilirliği tartışma konusu oldu. Gelişmiş ve gelişmekte olan ülkelerin büyümelerini olumsuz yönde etkileyen bu kriz, 2009 yılında dünya ekonomisinde %0.8'lik daralmaya neden olurken, Türkiye ekonomisi de 2009'un ilk çeyreğinde tarihinin en ciddi ekonomik daralmasını yaşadı.

Bugün küresel ekonomi krizden çıkıyor ama dünyanın bazı bölgeleri yeni krizlerle sarsılıyor. Krizle mücadele için gerçekleştirilebilen ülkelerarası koordinasyon kriz sonrası finansal mimarinin şekillendirilmesinde aynı hızla devreye sokulamıyor. Avrupa Birliği, bazı üye ülkelerin yüz yüze oldukları borç batağı sorununa kalıcı ve herke-

si rahatlatan bir çözüm üretmekte zorlanıyor. Ekonomik nedenlerle gerekçelendirilen ulusal sınırların içine yeniden çekilme tavrı, küreselleşme için bir risk oluşturuyor.

Son dönemlerin en ağır krizinin dip noktasını gördük ve çıkışın da işaretlerini hissettik. Dünya katma değerinin nerdeyse yüzde 10'una yakın bir destek paketi açıklanmış ve bu paketin önemli bir bölümü de uygulamaya koyulmuşken 2010 yılında hızlı bir çıkış görmek herhalde çok şaşırtıcı değil. Sayın Ayhan Köse'nin konuşması, kriz sonrası bizi bekleyen büyüme sürecinin dinamiklerine ışık tutacak.

Ancak bu çıkışın ne kadar sağlam ve ne kadar kalıcı olduğunu anlamak için öncelikle krizin nedenlerine bakmamız gerekiyor. Krizin nedeni yapısal nitelikte. Yani ülke ekonomilerinde makro politikaların yol açtığı bir ısınma ve buna bağlı oluşan bir "büyüme - küçülme" döngüsünden bahsetmiyoruz.

Krizin yapısal nedenleri arasında bir çok faktör var ama bunlar arasında en belirleyici olanı finansal regülasyon ve gözetimin küreselleşme sürecindeki hızlanmanın gerektirdiği noktanın gerisinde kalmış olması. Bu durumun sırf bir tesadüf olmayabileceğini, regülasyonlardaki zafiyetin küresel düzlemdeki tasarruf dengesizlikleri şişerken, mali akımlardan pay kapmayı kolaylaştırdığını da göz önüne almalıyız. Krizle mücadele için sarf edilmiş olan trilyonlarca dolara rağmen, meselelerin kökenindeki küresel dengesizlikler ve finansal regülasyon eksiklikleri sorunlarının hala tam olarak çözülmediğini hatırda tutmamız gerekiyor. Sayın Şebnem Kalemli'nin konuşması, bu konudaki düşüncelerimizi zenginleştirmemize imkan verecek.

Dolayısıyla, benzer bir krizi yeniden yaşamamak için finansal regülasyonların, küreselleşmenin doğal seyrine ayak uydurması gerekecek. Bu süreç iki biçimde işleyebilir. İlki ve açıkça tüm ülkelerin refah seviyeleri açısından daha arzu edileni küreselleşmenin ivmelenerek devam etmesi. Bir başka ifadeyle, küresel regülasyon ve denetim sisteminin, ülkeler arasındaki ekonomik entegrasyona uyumlu hale getirilmesi. Küresel krizle mücadelede ülkeler arası koordinasyonu sağlamak konusunda çok başarılı bir sınav vermiş olan G20 platformu tam anlamıyla kurumsallaşırsa küreselleşmenin bir sonraki evresine geçişte önemli bir adım atılmış olur.

İkinci alternatif ise küreselleşme sürecinin bir kez daha darbe almasıdır. Bu durumda her ülke kendi içine kapanır, piyasalar entegre olmayınca finansal piyasaların regülasyonu koordine etme ihtiyacı da ortadan kalkar ve içe kapanık bölgeci anlayış eski parlak günlerine döner.

Hiç şüphesiz birinci seçeneğin yanında olmak gerekiyor. Ama ilk seçenek ihtimalini riske sokan çok sayıda gelişme oluyor.

ABD'de, 2000'li yıllarda hem dünya ekonomisine, hem ABD ekonomisine büyük bir dinamizm sağlamış olan finansal inovasyona ciddi set vuracak, bankacılığı eski dar kalıplarına geri götürecek bir regülasyon anlayışı çok ciddi ve saygın isimlerden giderek artan bir destek buluyor.

Yunanistan krizi "Mali Kuralın" Avrupa Birliği içinde işletilmiyor olmasını su yüzüne çıkartıyor. Alınan trilyon dolarlık önlemlere rağmen Euro'daki değer kaybının önüne geçilememesi üzerine Almanya'daki düzenleyici otorite tek taraflı olarak harekete geçiyor.

Gelişmiş ülkelerde küreselleşme eğilimleri ile uyuşmayan bu hareketlere karşılık Doğu Asya ülkelerinde ekonomik milliyetçilik her zaman revaçta oldu. Bu ülkeler rekabetçi kur, katı faiz gibi klasik makro araçlar ile neredeyse gelirinin yüzde 50'sini tasarruf ediyor ve çok hızlı bir büyüme ve ihracat artışını sürdürebiliyorlar.

Küreselleşme sürecine zarar verebilecek bu eğilimler, krizde uygulanan hacimli destek programlarından zaman içinde ve yine ülkeler arasında koordinasyon ile vazgeçilmesi ihtiyacı açısından da zararlı. Bu koordinasyonun sağlanamaması, ya dünyayı yeni bir krizin eşiğine getirecek ya da enflasyonda dünya çapında bir yükselmeye yol açacak.

Küçük-açık ekonomi yapısından büyük-açık ekonomi hattında hareket eden, dış ticaret hacmi gelirinin yarısını oluşturan bir Türkiye, tüm küresel dalgalanmalardan eskiye göre çok daha fazla etkileniyor. Bu nedenle, küreselleşmenin derinleştirilmesi ile ulus devlet modeline geri dönülmesi arasındaki bu gelgitleri yakından takip etmek gerekiyor. Ama bir G20 üyesi olarak Türkiye, aynı zamanda dünyanın geleceğinin şekillendirilmesinde de söz sahibi. Türkiye tercihini küreselleşmenin kurum ve işleyişiyle tahkim edilerek geliştirilmesi doğrultusunda yaparken, kendi içindeki sorunları çözümleyerek küresel düzendeki yerini biraz daha sağlamlaştırmalı.

Önümüzde Türkiye için krizin yaralarının sarılmaya devam ettiği bir dönem var. Dunyadaki düzelme süreci yavaş ilerliyor ve küresel ekonomik faaliyet halen kriz öncesi seviyelerin altında. Küresel ekonomiye yönelik veriler 2009'un ikinci yarısı itibariyle düzelmenin başladığını gösterse de, bu düzelmenin 2010 yılında hangi ölçüde sürdürülebileceği halen netleşmedi. Küresel kriz neticesinde 2009 yılında %4.7 küçülmüş olan Türkiye ekonomisi 2010 yılında %5 civarında büyüyebilecek.

Ama geçen seneye göre iyi olmak demek, mutlak olarak iyi olmak anlamına da gelmiyor. Talep toparlanıyor, ama enflasyon ve cari açık da artıyor. Yeni istihdam yaratılıyor ama arzulanır düzeyde değil. Bu nedenle işsizlik oranı korkutmaya devam ediyor. Kamu açıkları Avrupa'yı sarsıyorken Türkiye mali kural açıklayarak çok olumlu bir adım atıyor ama sosyal harcamalarına ancak Avrupa'nın yarısı kadar pay ayırabiliyor. Yani zayıfların arasında hızla sıyrılıyoruz, ama en iyiye ulaşmak için daha çok yol kat etmek gerekiyor.

Bu süreçte hem para hem maliye politikalarının uyum içinde uygulanmasının yanı sıra kriz döneminde elde edilen düşük enflasyon, faiz ve cari işlemler açığı gibi gelişmelerin sürdürülebilirliği, Türkiye ekonomisinin geleceğine ilişkin duyulan güveni artıracak unsurlar olarak öne çıkıyor. Büyümeyi sürdürülebilir kılacak bu adımlar, küresel ekonomide meydana gelebilecek olası dalgalanmalar karşısında Türkiye ekonomisine manevra alanı yaratacak. Bu manevra alanı hem finans kesimi hem de reel kesim için çok önemli.

Küresel kriz sonrası dönemde ortaya çıkacak yeni düzenlemelerden en çok etkilenecek kesimlerden biri de şirketler kesimi olacak. Özellikle 2000'li yıllarda küresel likidite bolluğundan dünyadaki diğer firmalar gibi Türk firmaları da yararlanma olanağı bulmuş, bu firmalar piyasalardan ucuz ve bol şekilde borçlanma imkanı yakalamıştı. Borçlanma koşullarında görülen bu kolaylıklar ve imkanların çoğalması, şirketlerin karlılıklarını da önemli ölçüde arttırmalarına neden olmuştu. Fakat son yaşanan krizle birlikte küresel ekonomide bu model artık geçerliliğini yitirdi. Yeni dönemin koşullarına bugünden hazırlanmaya başlamazsak, yarın çok geç kalmış olacağız. Bu çerçevede kurumsal değişikliklerin etkileri üzerine Sayın Fabian Canova'nın aktaracağı AB'deki bulguların Türkiye için önemli derslere işaret edeceğini düşünüyorum.

***Değerli katılımcılar,***

Konuşmama son verirken, TÜSİAD-EAF ortak işbirliği ile düzenlenen bu konferansın başta yurtdışından gelen değerli iktisatçılar Adrian Pagan, Fabio Canova ve Ayhan Köse olmak üzere, tüm katılımcılarına yapacakları katkılar için çok teşekkür ediyorum. Bu konferansta ele alacağımız konuların bugün yaşadığımız krizi ve bu krizden çıkış için izleyeceğimiz politikalara ışık tutmasını diliyorum. Hepinize katılımlarınız için bir kez daha teşekkür ediyorum.

# A Glimpse into Fluctuations in Financial Markets

**M. Ayhan Kose[*] and Ezgi O. Ozturk[**]**

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**Abstract:** We study the main features of cyclical fluctuations in four distinct but interrelated financial markets credit, housing, equity, and foreign exchange using a comprehensive database of 21 OECD countries. We present a rich set of results. First, financial disruptions (booms) tend to be more pronounced and longer (shorter) compared to other cyclical episodes. Second, fluctuations in credit and housing markets exhibit the highest degree of synchronization. Third, cycles in credit and equity markets are often in the same phase across countries. Moreover, if there is a disruption (or a boom) episode already underway in one of the financial market segments, the likelihood of having a downturn (or an upturn) increases substantially for the other ones.

## I. Introduction

The global economy has been going through a period of pronounced turbulence over the past few years. Severe disruptions in financial markets led to the deepest global recession of the past seventy years in 2009. In addition to those advanced countries that had experienced booms in their credit and housing markets before 2007, a number of emerging and developing economies felt the adverse repercussions of the crisis through trade and financial market linkages. Thanks to the rapid rebound of activity in emerging market economies, some early signs of a global recovery have emerged over the past year. However, lingering sovereign debt problems in Europe and the lackluster performance of housing and labor markets in the United States suggest that the recovery is likely to be slow and fragile. Moreover, the deep scars left by the global recession are expected to be visible on both the real economy and financial markets for decades to come.

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** The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy.

Among the many lessons we learned from the crisis, one appears to loom above all: understanding the nature of fluctuations in financial markets has become more important now than ever before. Our objective in this paper is to provide a glimpse into the main features of the fluctuations in four different but interrelated segments of financial markets: credit, housing, equity, and foreign exchange. In addition to "normal" fluctuations, we also consider the extreme cases, such as booms and disruptions, in these markets. We document the basic features of fluctuations in financial markets, including duration, amplitude, slope, and synchronization across and within countries, using an extensive database covering a large number of advanced economies over a long period.

There has been a rich literature analyzing various aspects of financial market developments (see Claessens, Kose, and Terrones, 2010a, for a review).[1] Starting with Fisher (1933), a number of researchers emphasize the relevance of financial cycles for the real economy (see Sinai, 1992). For instance, the importance of credit for business cycles has been an intensive area of research, e.g., Bernanke, Gertler, and Gilchrist (1996), and Gilchrist and Zakrajsek (2008). There also have been a number of studies on cyclical fluctuations in credit, housing, and equity markets.[2]

It is well documented that exchange rates are detached from macroeconomic fundamentals in the short-run, and appear more influenced by news and other factors, such as the micro-structure of trading systems and order-flow. In the medium-to-long run, however, "macro" fundamentals re-assert their influence on the dynamics of exchange rates. For example, purchasing power parity has been found to have little explanatory value over short periods, but evidence is more favorable over longer periods (see Flood and Taylor, 1996). These observations can be interpreted as an indication of the presence of cyclical behavior in foreign exchange markets. Although this issue has not been studied in detail, there have been some early studies analyzing the driving forces of cycles in foreign exchange markets (see Stern, 1973).

Most of the literature on the dynamics of financial markets considers only selected aspects of fluctuations. For example, a number of studies examine the implications of only booms in asset prices and credit, rather than considering "full" cycles. Others

1 Claessens, Kose, and Terrones (2010a) provide a detailed analysis of the features of financial cycles in credit, housing and equity markets. This paper presents a summary of their findings and briefly examines the features of fluctuations in foreign exchange markets.

2 For extensive reviews of the literature on business and financial cycles and their interactions, see Claessens, Kose, and Terrones (2009, 2010a, and 2010b). Ivashina and Scharfstein (2010), Mian and Sufi (2010), and Malkiel (2007) analyze the features of cycles in credit, housing and equity markets respectively.

focus on financial crises the extreme versions of the downturn phases of fluctuations. Kindleberger and Aliber (2005) and Reinhart and Rogoff (2009) provide excellent historical accounts of financial crises.[3]

We extend this vast research program by providing a short summary of the salient features of fluctuations in the major financial markets. The rest of the paper is organized as follows: Section II describes our dataset and empirical methodology. In section III, we report our main findings. We provide some concluding remarks in section IV.

## II. Database and Methodology

### Database

We employ an extensive dataset of 21 advanced OECD countries over the 1960:1-2007:4 period.[4] In order to have complete financial cycles, we do not include the most recent wave of financial downturns during 2008-2010. The data are at the quarterly frequency, seasonally adjusted whenever necessary, and in constant prices. Our credit measure is the aggregate claims on the private sector by deposit money banks from the IMF-IFS Database. House price series we use correspond to various measures of indices of house or land prices depending on the source country. These series are mostly from the OECD. Equity prices are defined as share price indices weighted with the market value of outstanding shares from the IMF-IFS Database and DATASTREAM. Real effective exchange rates are our preferred measure of exchange rates and are collected from the IMF-IFS/INS Database.

### Methodology

In order to identify the cycles in financial markets, we employ the "classical" methodology which is widely used in the literature on business cycles.[5] The cycle dating algorithm we utilize is introduced by Harding and Pagan (2002a), which extends an early algorithm developed by Bry and Boschan (1971). An alternative methodology is

3 In addition to numerous papers, some recent books analyze the global financial crisis from different angles through the lens of history (see James (2009) and Ferguson (2009)).

4 The countries in our sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, Sweden, the United Kingdom, and the United States.

5 The "classical" definition of business cycles goes back to the pioneering work of Burns and Mitchell (1946) who laid the methodological foundation for the analysis of business cycles in the United States. See Stock and Watson (2010) and Sinai (2010) for recent examples of various business cycle dating methods.

to consider how each financial variable fluctuates around its trend (Stock and Watson, 1999). However, since our objective here is to produce a well defined chronology of financial cycles, we prefer the classical methodology rather than studying the second moments of fluctuations in financial markets.

It is useful to draw some parallels between the phases of cyclical fluctuations in financial markets we study here and those of business cycles. A complete business cycle comprises of two phases, the contraction or recession phase (from peak to trough) and the expansion phase (from trough to the next peak). In addition to these two phases, recoveries from recessions have been widely studied (see Eckstein and Sinai, 1986). The recovery phase is the early part of the expansion phase and is usually defined as the time it takes for output to rebound from its trough to the peak level just before the latest decline. Some others associate recovery with the growth achieved within a certain time period, such as four or six quarters, following the trough (see Sichel, 1994). Given their complementary nature, we use both definitions of recovery in our analysis of financial fluctuations below.

Our characterization of financial cycles closely follows that of business cycles. We call the recovery phase of a financial cycle the "upturn" and the contraction phase the "downturn". These two phases of financial cycles provide rather well-defined time windows. We do not study expansions, which are typically much longer, and can be affected by many structural factors (e.g., the level of the country's legal and institutional development greatly affects the scope for financial development) and initial conditions (e.g., the initial depth of the country's financial system has a substantial impact on the scope for long expansions in credit).

We study three main characteristics of financial cycles: duration, amplitude, and slope. The duration of a financial downturn (upturn) is the number of quarters between a peak (trough) and the next trough (the level at its last peak). The amplitude of a downturn measures the change in a financial variable from its peak to the next trough, whereas the amplitude for an upturn measures the change from its trough to the level reached in the first four quarters of the expansion. The slope of a downturn is the amplitude from peak to trough divided by the duration, whereas for an upturn it is the amplitude from the trough to the quarter at which the financial variable has reached the level at its last peak divided by the duration.

We also examine the more intense forms of financial cycles, disruptions and booms, and their implications. To identify these, we rank the changes in each variable during downturns and upturns. We then classify an episode as a financial disruption (boom) if the change in the variable during the downturn (upturn) falls into the bottom (top) quartile of all changes. We call disruptions crunches or busts depending on the variable (i.e., credit crunch, house or equity price bust). Similarly, we have credit, house, and equity price booms.

In addition, we study the degree of synchronization of financial cycles across countries/variables using the concordance index developed by Harding and Pagan (2002b). This index provides the fraction of time that the two series are in the same phase of their respective cycles. This definition implies that the two series are perfectly procyclical (countercyclical), if the concordance index is equal to unity (zero).

## III. Understanding Fluctuations in Financial Markets

### How many financial cycles?

We identify more than 750 financial cycles: the number of downturns (upturns) are 114 (115) in credit, 114 (114) in house prices, 245 (251) in equity prices and 279 (291) in exchange rates (**Figure 1A**). Equity prices and exchange rates are more volatile than credit and house prices, thus they feature more upturns and downturns. We analyze evolution of the frequency of cycles over time. We focus 1985 as our break point since it marks the beginning of the era of Great Moderation.[6] **Figure 1A** shows that there are more financial cycles in the 1960-1985 sub-period than in the 1986-2007 sub-period.

We compute the number of events per year to get a sense of the frequency of cycles in each sub-period given that the former is longer than the latter one (26 *vs.* 22 years). In the former, the frequency of cycles in credit and exchange rates is higher, whereas in the latter one it is higher for cycles in equity and house prices (**Figure 1B**). These findings point to two surprising observations. First, the first sub-period has more cycles in exchange rates even though it includes the Bretton Woods system of nominal fixed exchange rates. Second, although the frequency of cycles in housing and equity markets has increased over time, the changes appear to be rather small. This is an

6 See Stock and Watson (2005) about international aspects of the Great Moderation. For details about the time demarcation, see Kose, Prasad and Terrones (2003a, 2003b).

unexpected finding considering that most commentators argue financial markets have become more volatile over the past two decades.

Armed with a large number of cycles, we now turn to the main features of disruptions and booms in financial markets.

## How frequent, how long and how pronounced?

**Figure 2** shows the number of booms and disruptions over the full sample. It is important to note that we do not impose the equality of these events in different segments of financial markets. As one would expect, equity and exchange rate markets experience more booms and disruptions than do credit and housing markets. Credit crunches are more frequent than credit booms whereas housing markets exhibit the same number of booms and busts. Both equity and foreign exchange markets display more booms than disruptions. The number of equity price (exchange rate) booms is 63 (70), whereas it is 61 (69) for busts (collapses).

Financial disruptions (booms) tend to be longer (shorter) compared to other cyclical episodes. Housing booms are the longest whereas those in credit markets are the shortest (**Figure 3A**). A typical boom in credit markets is around 4.5 quarters while the average duration of other credit upturns is about 9 quarters. In housing markets, the difference between booms and other episodes is only two quarters. However, in equity and foreign exchange markets, booms often last a lot shorter than other upturns. An average equity price boom persists 8 quarters, whereas other upturns are on average 27 quarters. Similarly, a typical exchange rate boom lasts 6 quarters while an average upturn is about 17 quarters.

Disruptions (busts) in housing markets are often prolonged events with around 18 quarters (**Figure 3B**). The average duration of disruptions in other financial markets ranges between 8 (exchange rate) to 12 (equity price) quarters. Busts in financial markets often last longer than other downturns. For example, a house price bust is on average almost four times longer than other downturns in housing markets.

In order to study the amplitude of cycles, we compute the change in each financial variable during disruptions and booms (**Figures 4A-4B**). The most severe fluctuations take place in equity markets where prices register about 45 percent increase in a typi-

cal boom and a slightly larger decline during a bust episode. In the case of housing markets, the changes appear to be rather asymmetric across the two phases of the cycle: 11 percent increase during booms whereas 29 percent fall during busts. The changes in credit and exchange rates are similar during the boom and disruption phases of their respective cycles.

Equity prices exhibit more violent disruptions and booms than other financial variables (**Figures 5A-5B**). Measured by its slope, the strength of a typical credit boom is only one third of that of an equity boom. The episodes of exchange rate collapses are also quite violent although the slope of a typical collapse episode in foreign exchange markets is roughly half of that of an equity price bust. These findings are intuitively appealing since the volatility of equity prices and exchange rates is much larger than other financial variables.

## How synchronized are financial cycles?

Next, we examine the extent of synchronization of financial cycles within and across countries. We first compute the concordance index between financial cycles in each country and then report the median concordance statistic for both the full period and two sub-periods. Cycles in housing and credit markets display the highest degree of synchronization (**Figure 6A**).[7] In particular, cycles in credit and housing markets tend to be in the same phase about 70 percent of the sample. This is probably a result of the strong linkages between cycles in credit and housing markets stemming from the feedback effects between the two. The concordance statistics for cycles in equity prices are the lowest, implying that the linkages between equity and other financial markets are relatively weaker. As financial markets have become more sophisticated, linkages across different market segments have grown stronger over time, as evidenced by the slightly higher degree of synchronization in the latter period.

To analyze the degree of synchronization of financial cycles across countries, we first compute the concordance statistic for each country pair, and then calculate the median of the relevant statistic for each financial variable. For the full sample, credit cycles display the highest degree of synchronization, whereas housing cycles exhibit

7 Goodhart and Hofmann (2008) analyze the synchronization in house price and credit movements and state that the link between these two may arise via housing wealth and collateral effects on credit demand and supply; and via repercussions of credit supply fluctuations on house prices.

the lowest degree (**Figure 6B**).[8] The degree of synchronization in the case of housing and equity markets has increased over time probably because of stronger trade and financial linkages in the second sub-period.

### How likely are upturns (downturns) given booms (disruptions)?

We now briefly examine the likelihood of upturns and downturns conditional on disruptions and booms in financial markets (**Table 1A-1B**). The unconditional probability of being in a downturn or an upturn in any given quarter varies across financial cycles. For credit, the unconditional probability of being in a downturn (upturn) phase is 27 (21) percent. Asset prices have a higher likelihood of being in a downturn episode. For example, the likelihood of being in a downturn is 40 percent for house prices and 45 percent for equity prices.

If there is a financial disruption (or a boom) episode in the same quarter, the probability of having a downturn (or an upturn) increases substantially for most variables. The likelihood of a credit downturn (or upturn) taking place goes up by some 20 percentage points to 48 (47) percent if there is also a disruption (or boom) episode in house prices. Similarly, if a credit disruption (boom) is already underway, the probability of having a downturn (upturn) in house prices rises to 78 (46) percent. The likelihood of downturns and upturns also increase for equity prices, when these events coincide with disruptions and booms in credit and housing markets.

## IV. Concluding Remarks

In this paper, we provide a glimpse into the main features of fluctuations in financial markets considering the episodes of cycles, booms and disruptions from various perspectives. We focus on four distinct but interrelated financial markets: credit, housing, equity, and foreign exchange. We study three main characteristics of financial cycles: duration, amplitude, and slope. We also assess the extent of synchronization of these cycles within and across countries.

8 Hiebert and Vanteenskiste (2009) analyze the house price co-movement in the euro area, and show that spillovers from country specific house price shocks are relatively low. Mendoza and Terrones (2008) show that credit booms tend to be synchronized internationally and centered big events like the debt crisis of the early 1980s, the 1992 ERM crisis, or sudden stops in emerging markets. Terrones (2004) reports that house prices in advanced countries tend to move together and 40 percent of this co-movement can be explained by global developments.

We report a number of interesting facts: First, financial disruptions (booms) tend to be more pronounced and longer (shorter) compared to other cyclical episodes. Second, fluctuations in credit and housing markets exhibit the highest degree of synchronization. Third, movements in credit and equity markets are highly synchronized across countries. Moreover, the likelihood of having a downturn (or an upturn) increases substantially in most markets, if there is already a financial disruption (or a boom) episode underway in one of them.

Understanding fluctuations in financial markets is a fertile research field. For example, it would be very useful to undertake a detailed econometric analysis of the "determinants" of the duration and amplitude of financial cycles, focusing on country, institutional and financial market characteristics. In addition, it is necessary to provide a more comprehensive analysis of the upturn and expansion phases of financial cycles.

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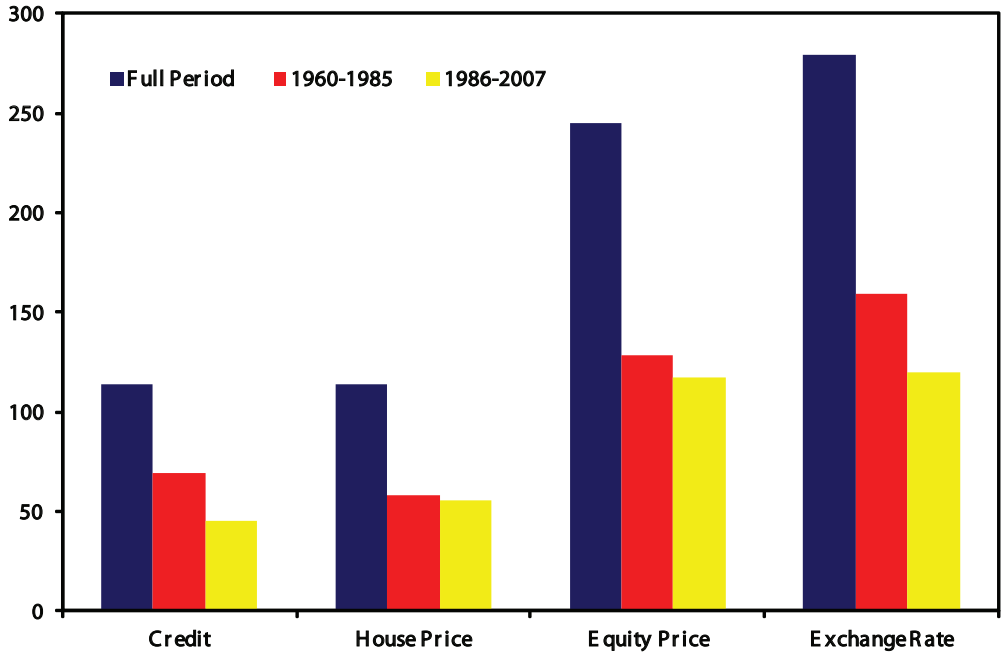
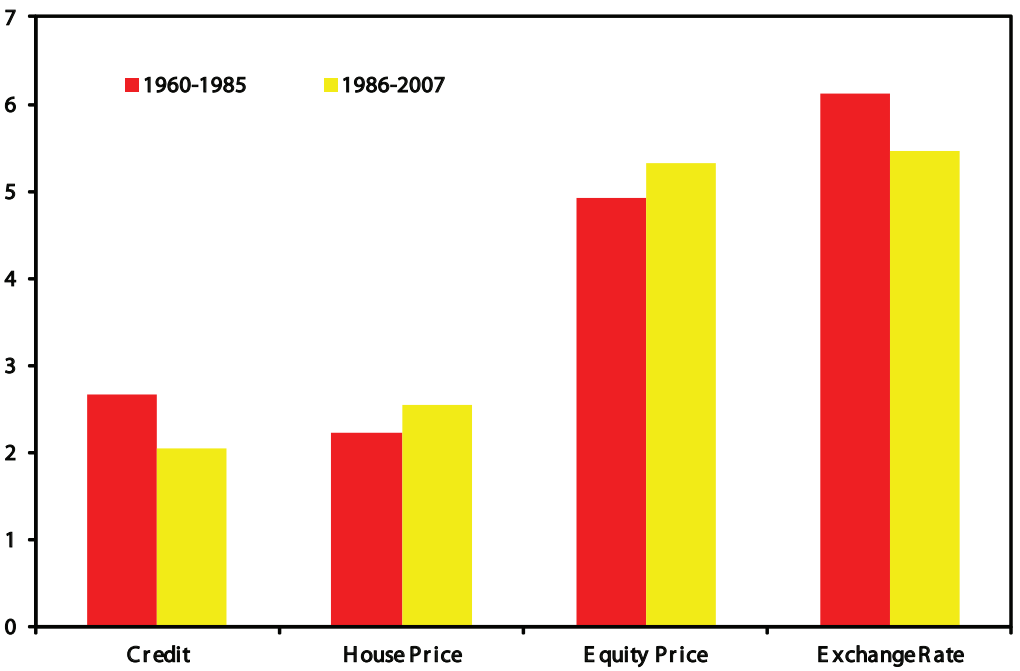
## Figure 1.A. Number of Financial Cycles



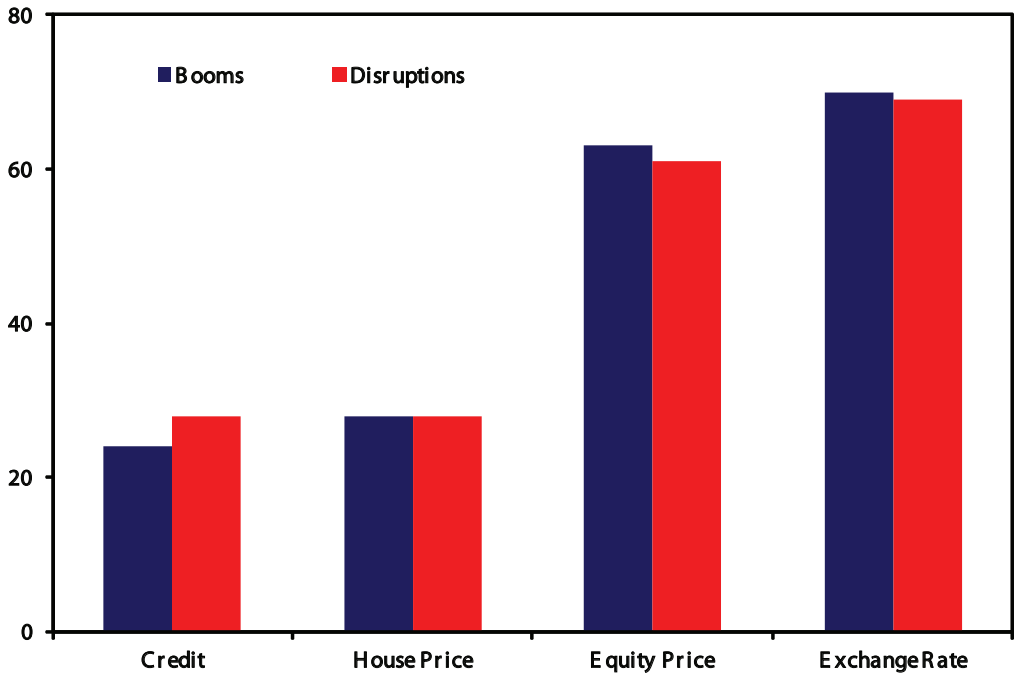

*Notes:* Each bar refers to the total number of respective cycle during the respective time period indicated.

## Figure 1.B. Frequency of Financial Cycles



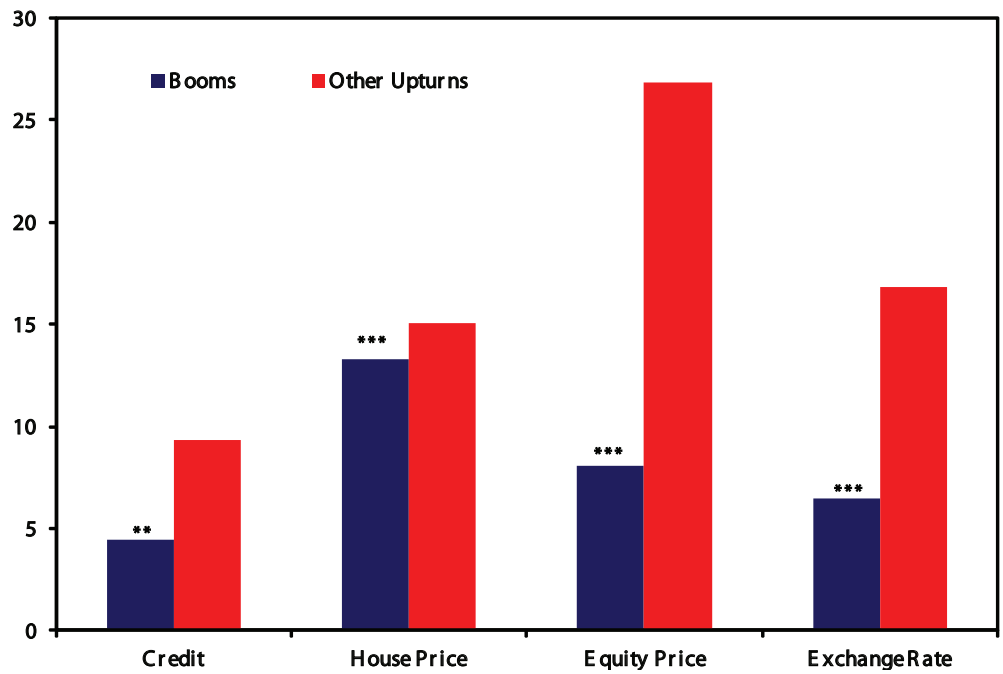

*Notes:* Each bar refers to the average number of respective cycle per year during the respective time period indicated.

## Figure 2. Number of Financial Booms and Disruptions



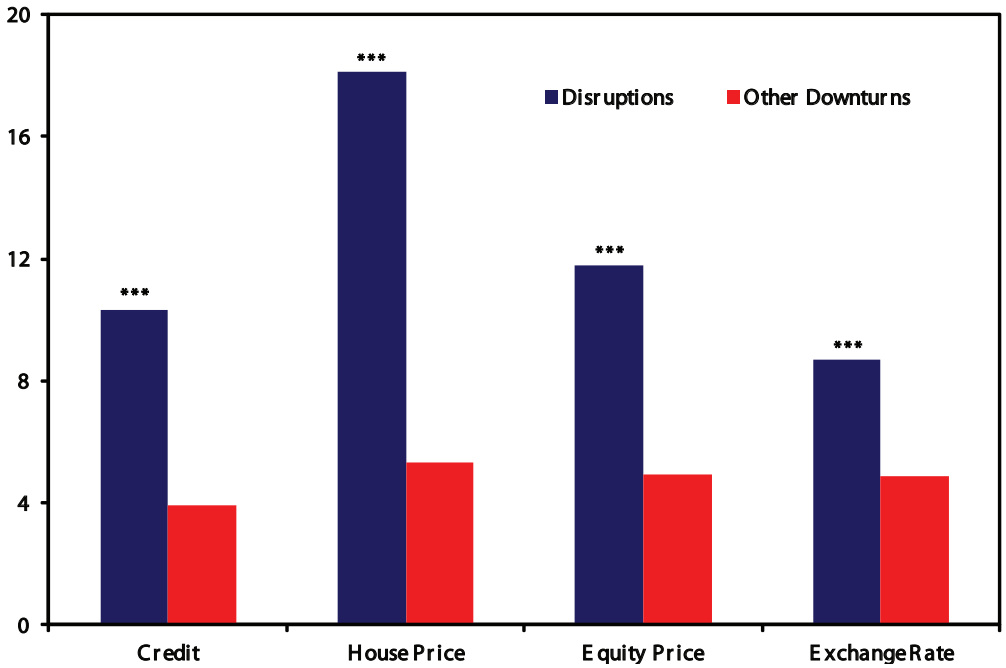

*Notes:* Each bar refers to the total number of respective booms or disruptions.

## Figure 3.A. Duration of Financial Booms



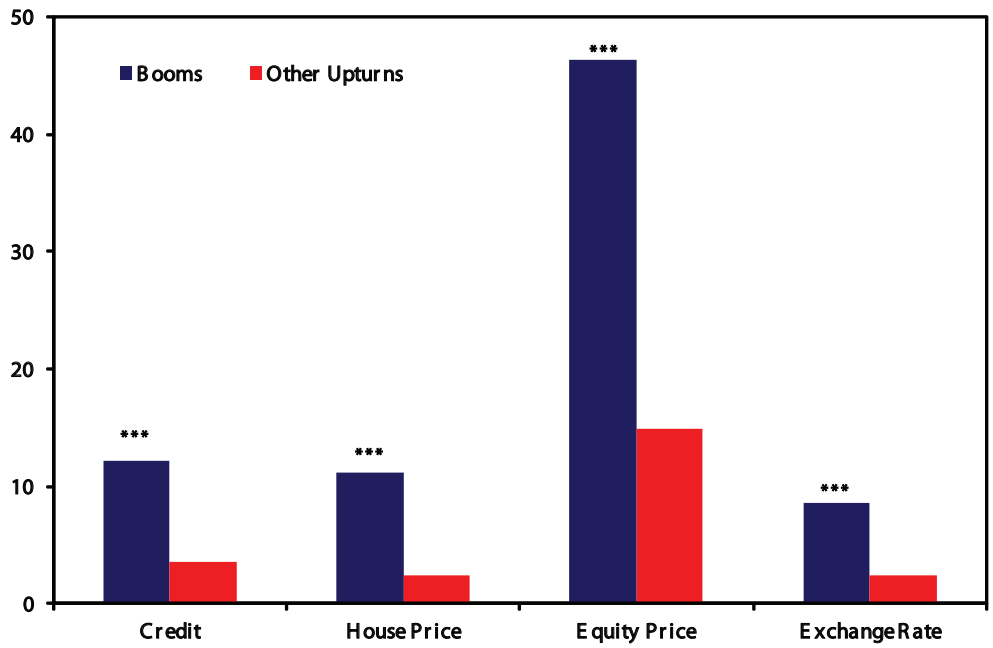

*Notes:* Each bar refers to the average duration of the respective financial booms and other upturns. Duration for upturns is the time it takes to attain the level at the previous peak after the trough. The symbols *, **, and *** indicate that the difference between medians of booms and other upturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 3.B. Duration of Financial Disruptions



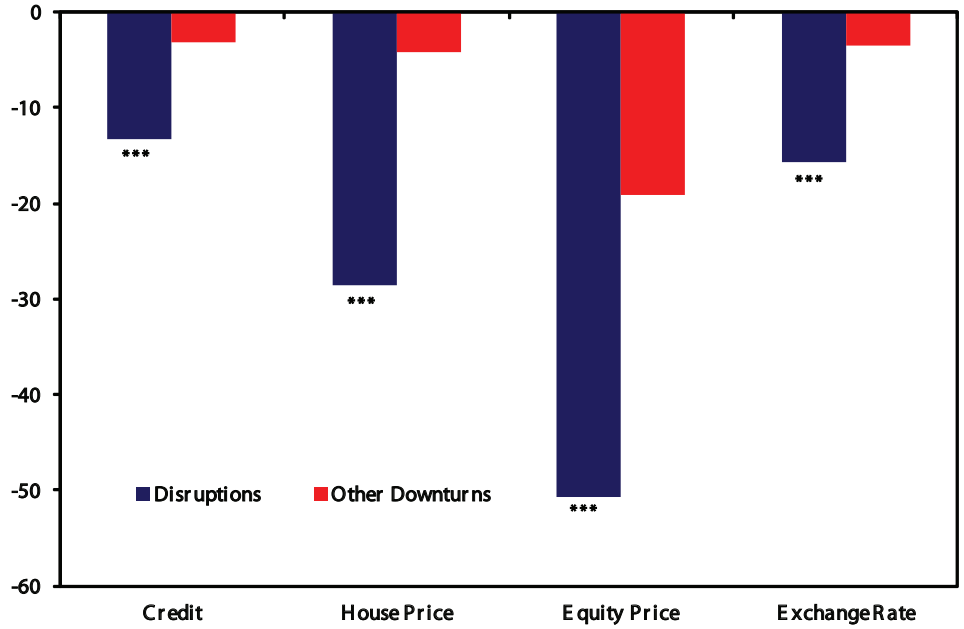

*Notes:* Each bar refers to the average duration of the respective financial disruptions and other downturns. Duration for downturns is the number of quarters between peak and trough. The symbols *, **, and *** indicate that the difference between medians of disruptions and other downturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 4.A. Financial Booms: Amplitude (in percent)



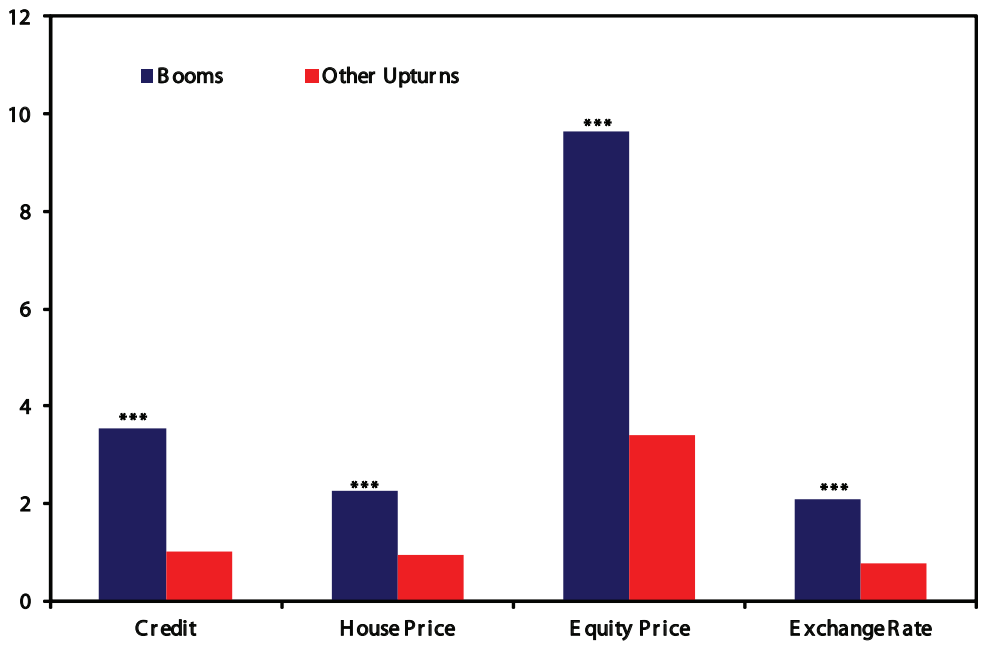

*Notes:* Each bar refers to the median amplitude of the respective financial booms and other upturns. Amplitude for upturns is calculated based on the one year change in each respective variable after the trough in each financial variable. The symbols *, **, and *** indicate that the difference between medians of booms and other upturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 4.B. Financial Disruptions: Amplitude *(in percent)*



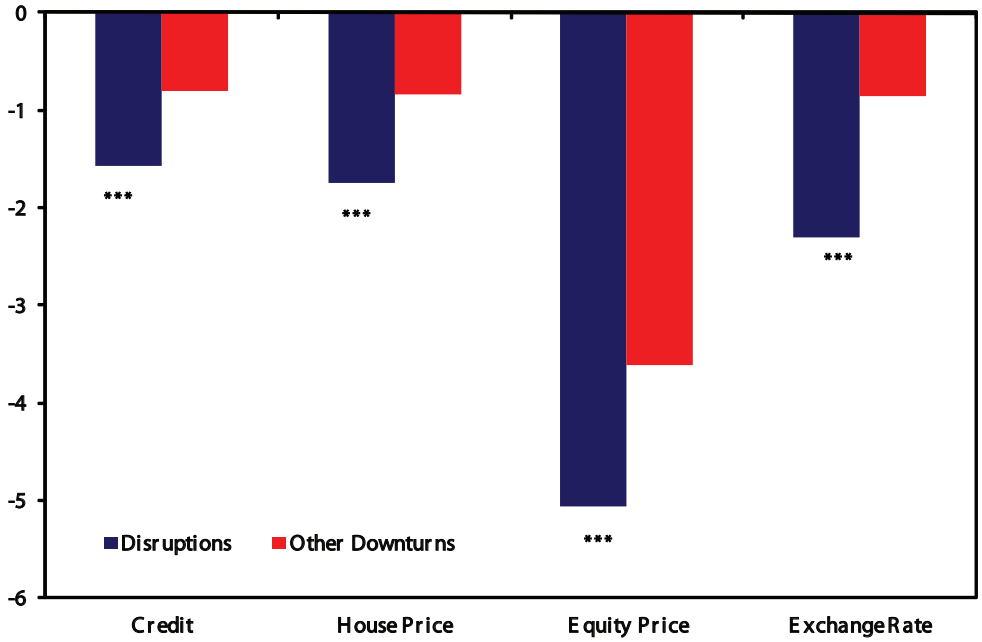

*Notes:* Each bar refers to the median amplitude of the respective financial disruptions and other downturns. Amplitude for downturns is calculated based on the decline in each respective variable during the downturn. The symbols *, **, and *** indicate that the difference between medians of disruptions and other downturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 5.A. Financial Booms: Slope



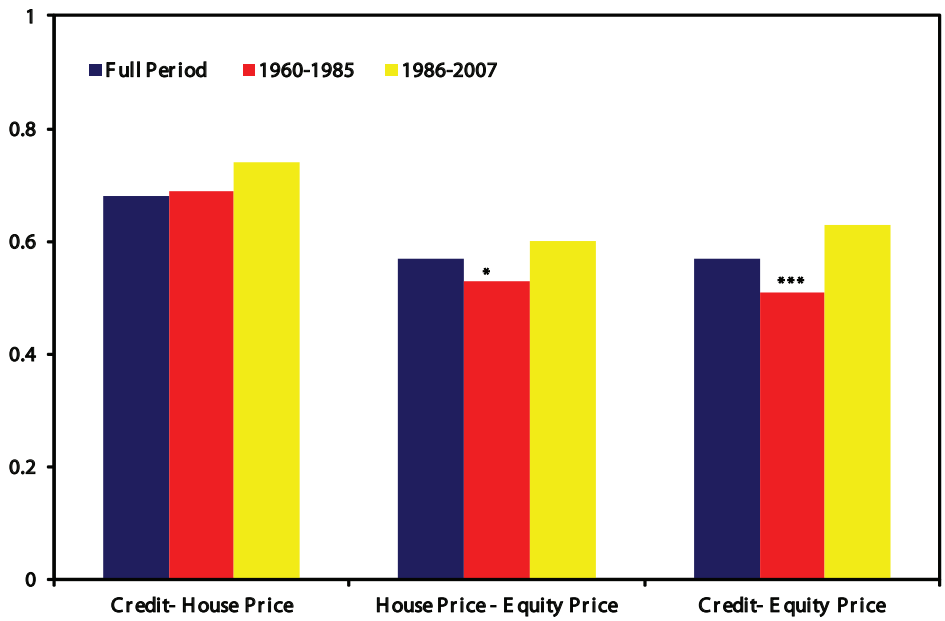

*Notes:* Each bar refers to the median slope of the respective financial booms and other upturns. The slope of upturns is the amplitude from the trough to the quarter at which the financial variable has reached the level at its last peak, divided by the duration. The symbols *, **, and *** indicate that the difference between medians of booms and other upturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 5.B. Financial Disruptions: Slope



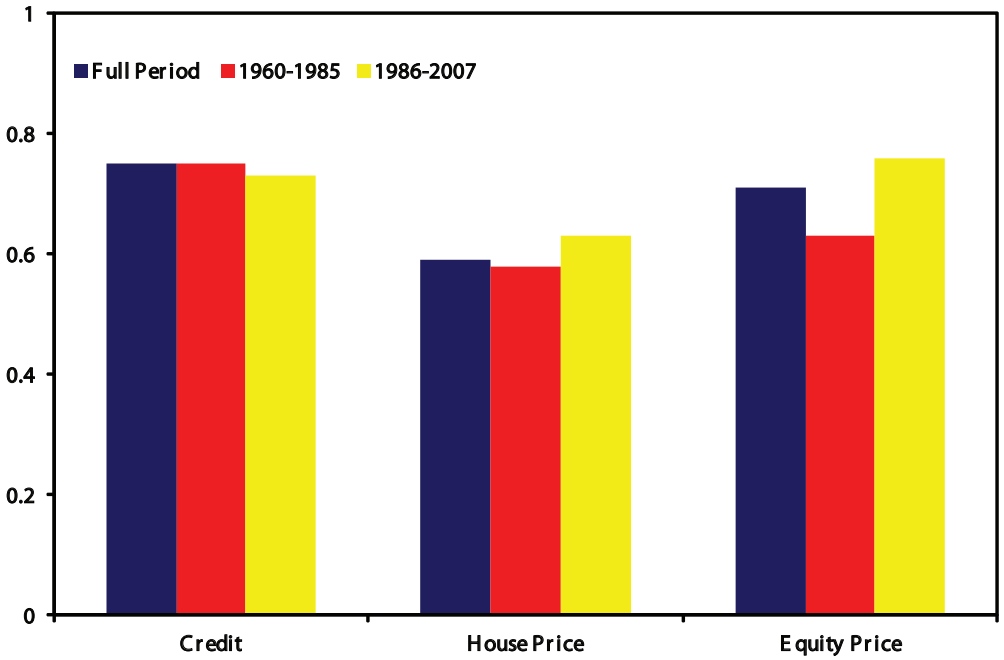

*Notes:* Each bar refers to the median slope of the respective financial disruption and other downturn. The slope of the downturns is the amplitude from peak to trough divided by the duration. The symbols *, **, and *** indicate that the difference between medians of disruptions and other downturns is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Figure 6.A. Concordance within Countries




*Notes*: Each bar refers to the median of the concordance statistic of the two respective cycles within countries. Concordance is calculated as the fraction of time that two cycles are in the same phase. First the concordance statistic for respective two cycles of each country is computed and then the median for respective two cycles over the full sample is calculated. *** implies significance at the 1% level, ** implies significance at the 5% level, and * implies significance at 10% level. Significance refers to the difference between the two sub-periods.

## Figure 6.B. Concordance across Countries




*Notes*: Each bar refers to the concordance statistic for the respective cycles across countries. Concordance is calculated as the fraction of time that two cycles are in the same phase. First the concordance statistic for each country pair is computed and then the median for each financial variable over the full sample is calculated.*** implies significance at the 1% level, ** implies significance at the 5% level, and * implies significance at 10% level. Significance refers to the difference between the two sub-periods.

## Table 1.A. Likelihood of Financial Upturns
## (in percent)

| *Probability of* | Credit Upturns | House Price Upturns | Equity Price Upturns | Exchange Rate Upturns |
|---|---|---|---|---|
| Unconditional | 21.12 | 31.36 | 38.68 | 29.75 |
| Conditional on Credit Boom | 100 | 45.76 | 51.97 | 33.71 |
| Conditional on House Price Boom | 47.37 | 100 | 54.07 | 48.33 |
| Conditional on Equity Price Boom | 26.19 | 38.73 | 100 | 41.88 |
| Conditional on Exchange Rate Boom | 23.79 | 37.01 | 42.15 | 100 |

## Table 1.B. Likelihood of Financial Downturns
## *(in percent)*

| *Probability of* | Credit Downturns | House Price Downturns | Equity Price Downturns | Exchange Rate Downturns |
|---|---|---|---|---|
| Unconditional | 26.96 | 40.52 | 45.46 | 44.1 |
| Conditional on Credit Crunch | 100 | 78.01 | 51.98 | 43.4 |
| Conditional on House Price Bust | 48.09 | 100 | 46.26 | 44.88 |
| Conditional on Equity Price Bust | 38.61 | 49.16 | 100 | 34.89 |
| Conditional on Exchange Rate Collap | 26.68 | 51.03 | 45.94 | 100 |

*Notes*: The unconditional probability of a downturn (upturn) is based on the fraction of time in which a downturn (upturn) occurs during the sample. The conditional probabilities refer to the fraction of time in which there is a downturn (upturn) given a financial disruption (boom).

# Financial Globalization, Financial Crises and International Business Cycle Synchronization

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While many commentators, academics, and policy makers argue that financial globalization has been a catalyst for the propagation of the 2007-2009 crisis from a corner of the US capital markets to the rest of the world, so far the tentative empirical evidence is mixed and inconclusive. Some studies for example show no systematic link between financial linkages to the US and the transmission of the crisis; other recent works suggest that countries with stronger financial linkages to the US capital markets did not experience sharper recessions as compared to less inter-connected economies. Not only the tentative evidence seems to contradict the conventional wisdom, but also the predictions of most theoretical models in international macro and corporate finance suggesting that by facilitating contagion, capital supply shocks will lead to more synchronized cycles among financially integrated economies.

This ambiguity is magnified because even before the recent crisis we lacked a good understanding of how financial integration affects the synchronization of the economic activity in regular times. Empirical works show a clear positive association between financial integration and output synchronization using data in the late 1990s and early 2000s. Yet this result is at odds with standard theory predicting that, in the absence of major financial shocks, there should be a negative association between financial globalization and the synchronization of economic activity. In the textbook international business cycle model, following an idiosyncratic country-specific productivity shock, the return to capital and labor increases, workers substitute leisure for work, and foreign capital flows to finance the rising investment opportunities; consequently output patterns among financially integrated countries diverge. The same result can be obtained from the corporate finance/banking models, where the dominant source of fluctuations is shocks to firms' productivity.

To make the long story short, there is a clear paradox between theoretical predictions and the main data patterns. While in regular times the partial correlation between financial integration and business cycle synchronization should be negative, cross-sectional and time-series empirical studies find a positive one. And while one could reconcile the positive association with financial frictions and shocks to the supply of capital, the tentative evidence from the recent crisis shows no systematic link between financial links to the US capital markets and the spread of the crisis. Moreover even if the data were to match the theoretical predictions, it will be premature to conclude that the simple correlations reflect causal relationships.

In a recent National Bureau of Economic Research (NBER) working paper, titled, "Financial Regulation, Financial Globalization, and the Synchronization of the Economic Activity," Elias Papaioannou, Jose-Luis Peydro and I attempt to identify the one way effect of financial integration on international business cycle synchronization using a unique dataset of bilateral external positions and a novel instrumental variables method. For our analysis we exploit a confidential dataset that covers all international bilateral banking activities for the twenty largest economies over the past three decades. The rich structure of our data is essential as it allows us to account econometrically for many sources of heterogeneity and biases. Most importantly by exploiting the considerable time-dimension we can investigate whether business cycles among any two countries become more or less synchronized as the two economies become more interlinked. Due to data limitations, previous works could not directly address this question, because most databases on bilateral international positions report statistics only for the past decade as an average. The limitation of our data is that it covers only the international exposure of banks and does not record investments by mutual funds, other than banks institutional investors (such as hedge funds), and other types of foreign investment. Yet banking activities are by far the largest component of total international assets and liabilities accounting for half of the total foreign positions of our group of industrial economies (for comparison the sum of portfolio equity investment and foreign direct investment account for roughly a third of total external positions). Moreover as recent databases reveal a strong correlation between all types of international investment holdings and flows, the banking statistics reflect most likely all external positions.

The three-dimensional panel structure of our dataset enables to control for global trends and common to all countries shocks, such as the increased co-ordination of mo-

netary policy, outsourcing, and other features of globalization, over a prolonged period of time. Quite importantly we also account for all (to a first-approximation) time-invariant country-pair factors, related to trust, distance, information asymmetries that previous research shows that crucially affect both integration and output fluctuations. Besides these straightforward technical merits, by exploiting the within country-pair variation of the data we can address directly the relevant policy question: Do increases in bilateral financial linkages makes economic activity more or less synchronized?

In the first part of our analysis we show with simple econometric methods (ordinary least squares) that accounting for common to all countries shocks and country-pair fixed-factors are fundamental. Across country-pairs there is a significant positive correlation between financial integration and output synchronization; this comes at no surprise. The business cycle of the US economy is much more synchronized and more financially linked with Canada, as compared to Germany or France, which are themselves more synchronized and also more interconnected. Yet, in sharp contrast to the clearly positive cross-sectional correlation, when we examine the within country-pair response of output synchronization on increases in bilateral financial linkages we find a significantly negative association. This implies that increases in financial integration within each country-pair (say Canada-US or France-Germany) are associated on average with less synchronized, more divergent, output cycles. The negative within association between bilateral financial linkages and business cycle co-movement is in line with the standard textbook models in international macro that imply that in the absence of capital supply shocks, financial integration should magnify total-factor-productivity shocks and make output patterns to diverge.

Yet our results may be driven by output divergence leading to a higher degree of financial integration rather than the other way around. Reverse causation can not be ruled out, because the benefits of international diversification become larger the less synchronized equity returns are. According to the logic of the textbook international mean-variance model, capital should thus move in countries with asynchronous output cycles.

A further concern with the panel estimates is that one can not rule out that another -not related to financial (or trade) integration- country-pair time-varying factor is spuriously driving the correlation between financial integration and synchronization.

Another open issue is how potential measurement error in the proxy measure of financial globalization is affecting the estimates. While the BIS statistics reflect all on balance-sheet international exposure of banks and thus classical error-in-variables is minor, our data do not include other types of international investment. Moreover, due to the hub nature of international banking, almost all datasets of international investment holdings miss indirect exposures (i.e. a Canadian investment in Austria will most likely occur through New York and/or Luxemburg) and investments through off-shore centers (such as the Cayman islands or the Channel Islands).

To account for these (endogeneity) concerns in the second part of our paper we develop a novel country-pair panel instrumental variables identification scheme that links legal-regulatory harmonization reforms in financial services with bilateral banking activities in a first-stage empirical model and in turn (in the second stage) with output synchronization. This approach has some nice features. From an econometric standpoint, under instrument validity, this method accounts for all sorts of biases arising from reverse causation, omitted-variables bias, and measurement error. From a policy standpoint, as many countries are currently in a process to redesign the regulatory framework of financial intermediation, our two stage empirical framework enables us to understand how such reforms may affect output synchronization through international financial integration.

Our policy instrument for bilateral banking activities reflects regulatory-legislative financial sector harmonization policies in the European Union (EU) economies (our sample of 20 advanced economies includes the initial EU15 countries). In the end of the 1990s the main legislative bodies of the EU launched a major policy reform package, the Financial Services Action Plan (FSAP). The FSAP aimed to remove barriers to the movement of capital across Europe by harmonizing the regulatory framework of financial intermediation across the EU. The program included 29 major legislative acts, 27 Directives and 2 Regulations in the areas of securities regulation (e.g. Prospectus Directive), insurance (e.g. Solvency Directive), corporate fraud (e.g. Directive on Insider Trading), corporate governance (e.g. Transparency Directive), and banking (e.g. Directive on Capital Adequacy). In contrast to EU Regulations that become instantly enforceable, Directives are legal acts that do not become immediately enforceable across the EU. Instead, member countries are given time to adopt, modify, and eventually transpose the Directives into domestic law. Due to bureaucratic inefficiencies, policy

considerations, and other frictions, the transposition process is notoriously slow and it is not uncommon for member countries to delay the adaptation of the Directives for more than five years. For identification we thus exploit differences on the transposition timing of each of the 27 Directives of the FSAP. Building on our parallel research on the roots of the recent spur of financial integration in Europe, we construct a bilateral time-varying index of legislative-regulatory harmonization policies in financial intermediation that is increasing when both countries have transposed the exact same Directive of the FSAP in each year. We then associate this legislative harmonization index in financial services with bilateral banking activities in the first-stage and in turn with output synchronization.

This identification strategy is appealing as it links regulatory-legislative reforms in financial intermediation with outcomes (banking integration) in exactly the same sector of the economy and in turn to international output synchronization. The so-called exogeneity assumption for instrument validity is plausible because legislative reforms are at the country-level, while the outcomes we study are bilateral. The so-called exclusivity assumption for instrument validity is also credible because harmonization policies in financial intermediation should affect the synchronization of economic activity primarily by altering cross-border financial activities. As the FSAP was initiated, designed, and implemented with the explicit goal to integrate capital markets among EU member countries, it is quite reasonable that (conditional on other country-pair time-varying factors) it should affect output synchronization by spurring financial integration.

The first-stage specifications reveal that cross-border banking activities increase significantly when countries homogenize the rules governing the function of financial intermediation. The first-stage relationship is strong, even when we condition on the flexibility of the exchange rate regime (i.e. that captures the direct effect of the euro), trade, and other (country-pair time-varying) factors. This suggests that a considerable part of the overall positive effect of the single currency in spurring financial integration in Europe comes from regulatory-legislative convergence.

The second-stage estimates show that, conditional on common to all countries shocks and country-pair time-invariant factors, the component of banking integration predicted by legislative-regulatory harmonization policies in financial intermediation tends to make business cycles less alike.

We also estimate simple panel specifications that associate output synchronization with the bilateral index of legislative-regulatory harmonization policies in financial services. The so-called "reduced-form" estimates are particularly interesting in our set-up because the harmonization index that we use as an "instrument" for identification in the IV models is a structural measure of financial integration. In line with our simple panel least squares estimates, we find that conditional on common trends and country-pair time-invariant characteristics, convergence policies in financial intermediation are followed by more divergent output cycles.

Thus both the LS and the IV results suggest that financial globalization has led to more divergent output cycles. Yet this negative association was masked, because over the past two-and-a-half decades the spur in financial globalization coincided with an increased degree of business cycles convergence.

Our results do not imply that financial integration has not contributed to the spread of the recent financial crisis from the US to the global economy. Theory makes sharply different predictions on the effect of financial linkages on the propagation of country-specific productivity ("real") as opposed to financial shocks. We have thus intentionally decided to focus on a group of advanced economies in a period of unprecedented financial stability (from the late seventies till 2007) to examine the effect of financial integration on the propagation of productivity driven shocks.

In another recent paper titled, "Global Banks and Crisis Transmission," Elias Papaioannou, Fabrizio Perri and I, investigate exactly this issue. We extend our data set till the end of 2009 and study how the 2007-2009 crisis has changed the impact of financial integration on the transmission of international business cycles. We find that while the relationship between financial linkages and synchronization of output was negative before as consistent with the above paper (increases in financial linkages were associated with divergent output cycles), this effect turns out to be positive during the recent crisis (more integrated countries now co-move more). We document that countries with stronger financial ties to the US and the Cayman Islands experienced more synchronized cycles with the US. This is the first paper so far in the literature that shows robust evidence on the transmission of the crisis from the US to the rest of the developed world via financial linkages.

We then develop a simple general equilibrium model of international banking allowing for both productivity and credit shocks. Our model delivers the following predictions. Under the assumption that the productivity shocks are the dominant source of fluctuations, a higher level of banking integration results in less synchronized business cycles, whereas if financial shocks become the dominant source of fluctuations, then a higher level of banking integration results in less synchronized business cycles. These predictions are fully consistent with our empirical findings.

Overall, the above summarized work from two different papers has hopefully shown that policy recommendations based on simple time-series or cross-sectional correlations can be quite misleading. One needs to carefully bring theory to the data and pay attention to tricky issues arising from the measurement of international financial linkages, the isolation of productivity from financial shocks, and also account for other forms of endogeneity.

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# Business Cycles in Mexico and Turkey

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## 1. Introduction

The analysis of business cycles in emerging economies has gained impetus in recent years. One approach has been to understand how business cycles in developed and developing economies differ (see, for example, Köse, Otrok and Whiteman, 2003 and Köse, Otrok, and Prasad, 2008). The analysis of business cycles has also been conducted using a variety of methods. These range from examining the correlations and cross-correlations of filtered economic time series following the approach in Kydland and Prescott (1982) or Backus and Kehoe (1992) to the modeling economic time series using non-linear approaches pioneered by Neftçi (1984) or Hamilton (1989). Beginning with Burns and Mitchell (1946) at the NBER, there also exist nonparametric approaches for characterizing business cycles (see Bry and Boschan, 1971). More recently, Harding and Pagan (2002) adapt the nonparametric Bry-Boschan model for determining business cycle turning points to a quarterly level and also provide a statistical foundation for their approach by linking the moments of the underlying series to characteristics of business cycles such as the probability of a peak or a trough or the duration of the business cycle.

A variety of papers have implemented these approaches to identify the nature of business cycles in specific country groupings. Girardin (2005) examines growth cycles for East Asian countries using the Markov-switching model while Aolfi, Catao and Timmerman (2010) identify common features in business cycles for four Latin American countries. Rand and Tarp (2000) examine business cycles in developing countries using the non-parametric approach and correlations based on Hodrick-Prescott filtered

data. More recently, Altug and Bildirici (2010) use both parametric and nonparametric approaches to examine business cycle phenomena for 24 developed and developing countries. Likewise, Altuğ, Tan and Gencer (2010) use Markov-chain based estimates and tests to analyze the cyclical dynamics of industrial production and employment growth for a similar set of countries. The set of countries these authors consider includes Mexico and Turkey. In this study, we will summarize their findings and discuss the underlying factors that lead to the observed business cycles in two key developing economies.

Earlier studies that examined the behavior of real and financial variables for Mexico and Turkey include Altuğ and Yılmaz (1998) and Alper (1998, 2002). The former study examined the dynamic interrelationships among ex-ante real interest rates, inflation, and industrial production over the period 1988-1997. Alper (2002) examines the stylized facts for business cycles in Mexico and Turkey using correlations and cross-correlations of filtered series. There are several reasons for analyzing the cyclical performance of two countries such as Mexico and Turkey. First, both countries are among the larger emerging market economies and they both have memberships in trade arrangements involving their region. Mexico is a member of the North American Free Trade Agreement (NAFTA) while Turkey entered into a customs union agreement with the European Union in 1996 and possesses candidate status for full EU membership as of 1999. Second, both countries have experienced a long process of adjustment which includes trade and financial liberalization as well as programs of stabilization and reform.

The remainder of this paper is organized as follows. Section 2 described the methodology while Section 3 presents the results. Some concluding comments are in Section 4.

## 2. Methodology

In this study, we make us of the results of two approaches to characterize cyclical phenomena in Mexico and Turkey. The first is the univariate Markov stitching model augmented with deterministic trends proposed by Hamilton (1989). The second consists of the nonparametric approach of Harding and Pagan (2002) for identifying the turning points in economic time series.

Beginning with the first approach, suppose there is an unobserved Markov state variable $s_t$, which can take on a number of discrete values. For example, $s_t=i$, $i=1,\ldots,3$, where $s_t=1$ denotes a "low growth" regime, $s_t=2$ denotes "normal growth", and $s_t=3$ denotes "high growth". Let $y_t$ denote the growth rate of real GDP or equivalently, its log difference, and assume that the process for $y_t$ is a univariate auto-regression with regime switches such that:

$$y_t = v(s_t) + \phi(s_t)\delta(t) + \sum_{j=1}^{p} a_j(s_{t-j})y_{t-j} + \sigma(s_t)\varepsilon_t, \qquad (2.1)$$

where $\{\varepsilon_t\}_{t=0}^{\infty}$ is an i.i.d. process such that $\varepsilon_t \mid s_t \sim N(0,\sigma(s_t)^2)$. The specification in which the intercept varies with the underlying state $s_t$ is typically used when the mean of the process varies smoothly across regimes.[1] In this expression, $\delta(t)$ denotes a deterministic polynomial in time with a potentially regime-switching coefficient. The dynamics of the $\{y_t\}$ process is completely determined once we specify a probability rule for the evolution of the unobserved state, $s_t$. A usual assumption is that $s_t$ evolves as a finite first-order Markov process with transition probabilities

$$Pr(s_{t+1} = j \mid s_t=i, s_{t-1}=k,\ldots) = Pr(s_{t+1}=j \mid s_t=i) = p_{ij}, \; i,j=1,\ldots,m, \qquad (2.2)$$

where $p_{ij}$ is the probability that state i will be followed by state j and

$$\sum_{j=1}^{m} p_{ij}=1, \; i=1,\ldots,m \text{ and } 0 \le p_{ij} \le 1.$$

The estimation of the Markov switching model follows Hamilton (1989). Krolzig (1997) provides an extension to the multivariate case.

As an alternative approach, Harding and Pagan (2002) have proposed a modification to the Bry-Boschan algorithm -- the so-called BBQ algorithm -- that can be used to identify the peaks and troughs of the classical cycle at a quarterly frequency. We now briefly describe this approach and compare the results with those we discussed

1 Notice that the mean of the process is related to the intercept and autoregressive parameters as $\mu(s_t) = v(s_t)/(1-\sum_{j=1}^{p} a_j(s_{i-j}))$.

above. Let $y_t$ denote the (logarithm) of real GDP at time t. The BBQ algorithm identifies a trough at time t if $\{\Delta^2 y_t<0, \Delta y_t<0, \Delta y_{t+1}>0, \Delta^2 y_{t+2}>0\}$ where $\Delta^2 y_t = y_t - y_{t-2}$ and a peak if $\{\Delta^2 y_t>0, \Delta y_t>0, \Delta y_{t+1}<0, \Delta^2 y_{t+2}<0\}$. These conditions yield the turning points for classical cycles, as defined by the NBER methodology.[2] There are also a variety of measures that can be used to examine the characteristics of the phases of a business cycle. These include the duration, amplitude, asymmetry and cumulative movements of the phases of the cycle. To describe these measures, let $D_i$ be the duration of a business cycle phase, say a recession or an expansion, and let $A_i$ denote its amplitude. If the consecutive turning points fall on the dates t and t+d, then $D_i$=d and $A_i = y_{t+d} - y_t = \Delta^d y_t$. If the duration and amplitude are thought to form a triangle, then the area of the triangle measures the loss (gain) of a recession (expansion). Let $C_{Ti}$=0.5$D_i$ x $A_i$ denote the triangle approximation to the cumulated movements of the series over a business cycle phase, $C_i$ be the actual movement defined as $C_i$ = 0.5 $A_i+\Sigma_{s=1}^{d-1}\Delta_s y_{t+s}$, and $E_i$=100\times ($C_{Ti}$-$C_i$)/$C_i$ be the measure of excess cumulated movement as a percentage of the actual cumulated movements.

## Results

Our data are quarterly GDP at constant prices measured in units of the national currency.[3] Let $y_{i,t} = \ln(Y_{i,t})$ where $Y_{i,t}$ denotes real GDP of country $i$ in quarter $t$. We take the annual quarter-to-quarter growth rate of GDP for country $i$ as $\Delta y_{i,t} = \ln(Y_{i,t}) - \ln(Y_{i,t-4})$. For seasonally unadjusted data, this transformation tends to eliminate any seasonal effects that might exist at the quarterly frequency. Following Stock and Watson (2005), we smoothed out high frequency movements in the different series by taking four-quarter averages of the annual quarter-to-quarter growth rates.

Table 1 displays the characteristics of the estimated Markov switching models for Mexico and Turkey, respectively, as well as the statistics based on the non-parametric Harding-Pagan approach. The estimated Markov switching models for both Mexico and Turkey are chosen to be 2-regime models.[4] Turning to the characteristics of the

2 A natural requirement that is imposed is that peaks and troughs alternate. In the event that this condition fails, the least pronounced of the adjacent turning points is deleted.

3 See Altuğ and Bildirici (2010) for a further description of the data sources.

4 We refer the reader to Altuğ and Bildirici (2010) for a further description of the estimated Markov switching models for the countries in question. We fail to reject the 2-regime model for Turkey based on the modified likelihood ratio test and other model selection criteria. While there is some evidence against the 2-regime model for Mexico, it is not overwhelmingly strong.

implied models, we find that recessions (Regime 1) are associated with significant output declines for both Mexico and Turkey, and that the magnitudes of these declines are also significant. We also find that expansions (Regime 2) are associated with significant output increases for both countries, though the magnitude of this increase is larger for Turkey.[5] Another salient difference that we observe between the estimated solutions for the two countries lies in the durations of recessions and expansions. For Mexico recessions tend to more twice as long as those for Turkey. However, Mexico also tends to experience considerably longer expansions. The nonparametric Harding-Pagan approach attributes slightly longer recessions to Mexico than it does Turkey. However, it also attributes considerably longer expansions for Mexico. Furthermore, the amplitudes during contractions and expansions tend to be similar for Mexico and Turkey, respectively. However, there are differences in the shapes of the cycle across the different phases. We discuss the differences in the length of recessions based on the two approaches after we provide a list of the business cycle turning points for each country.

In their estimated vector auto-regression models for Mexico and Turkey, Altuğ and Yılmaz (1998) examine a multivariate system consisting of real stock returns, the real return on 3-month T-bills, real exchange rates and de-trended industrial production for both Mexico and Turkey over the period 1988-1997. They find that the real effects of inflation and real exchange rate shocks on industrial production differ in Mexico versus Turkey. Recall that the sample period over which the analysis is conducted ranges from 1988 to 1997 for both countries. A little-noticed similarity between Turkey and Mexico is that both countries suffered balance-of-payments crises in 1994 and 1995, respectively. As in Mexico, the crisis in Turkey was preceded by capital inflows, exchange rate appreciation, an expansion of domestic credit, and increasing fragility of the banking sector due to expansion of bank assets and liabilities.[6] These balance-of-payments crises led to large real devaluations of the domestic currencies in both countries as well as increases in inflation and sharp contractions of real output.

5 This result also holds after controlling for the estimated trends in GDP growth for each country.

6 See Calvo and Mendoza (1996) and Edwards and Vegh (1996) for a discussion of the events surrounding the Mexican 1995 crisis.

| | Mexico | Turkey |
|---|---|---|
| **Markov Switching Approach** | | |
| Means | | |
| $\mu(s_1)$ | -2.04** | -2.64** |
| $\mu(s_2)$ | 3.30** | 6.61** |
| | | |
| Trends | | |
| $\mu(\tau)(s_1)$ | 0.0041 | -0.0013 |
| | | |
| Durations | | |
| $D_1$ | 9.99 | 4.12 |
| $D_2$ | 17.54 | 11.52 |
| | | |
| **Harding-Pagan Approach** | | |
| Duration (PT) | 4.50 | 3.60 |
| Duration (TP) | 21.75 | 12.40 |
| Amplitude (PT) | -4.00 | -4.430 |
| Amplitude (TP) | 19.66 | 25.35 |
| Excess (PT) | 7.493 | -0.127 |
| Excess (TP) | 0.377 | 6.157 |

** Significant at the 5% level

**Table 1: Characteristics of the Estimated Models**

Altuğ and Yılmaz (1998) find that for Turkey "a one-standard deviation inflation shock leads to an immediate negative response in industrial production. Furthermore, the negative impact of the shock to inflation tends to persist up to seven months, but it is marginally significant." Ersel and Sak (1996) have argued that the private sector was able to survive the effects of the 1994 crisis without widespread bankruptcies because firms recouped their losses in production through non-operational profits from their financial investments. For Mexico, unexpected devaluation turns out to be the most important determinant of changes in de-trended industrial production for the period in question, explaining over 8 % of the 12-month-ahead forecast error variance in this va-

riable. Not only is the initial impact of an unexpected shock to changes in the real exchange rate negative but this effect persists and is amplified up to eight months before becoming smaller. Given the sample period, we can view inflation and real exchange shocks as proxying for the effects of crises that these countries experienced in 1994 and 1995, respectively. Hence, the findings of Altuğ and Yılmaz (1998) provide some justification for the differences in the length of recessions for these countries.

In Table 2, we also provide the recession dates found according to the Markov switching and Harding-Pagan approaches for Mexico and Turkey and compare them to the Economic Cycle Research Institute (ECRI) dates where available. In this table, we observe that ECRI dates two different recessions in Mexico in the 1980's period whereas the MS model that we estimate essentially views the entire period 1982:3-1986:4 as a single recession. Hence, this may also explain the differences in the length of the recessions that we obtain from the MS model relative to the Harding-Pagan BBQ algorithm. However, Mexico also experiences a long recession during 2000-2003, which is also indicated by ECRI and the MS model. By contrast, the Harding-Pagan assigns a shorter duration to the recession in Mexico that began in late 2000, which is captured better by the MS model. Hence, these findings provide evidence for recessions that tend to be longer in Mexico than attributed by the Harding-Pagan approach but perhaps shorter compared to the results of the MS model. By contrast, we find that both the MS model and the BBQ algorithm agree more closely on the business cycle dates for Turkey.

| **Mexico** | | | **Turkey** | |
|---|---|---|---|---|
| **ECRI** | **MS model** | **BBQ** | **MS model** | **BBQ** |
| 82:1-83:3 | 82:3-86:1 | 82:2-83:4 | | |
| 85:4-86:4 | | 85:4-87:1 | 89:2-89:3 | 88:3-89:2 |
| 92:4-93:4 | | | 91:1-91:3 | 90:4-91:2 |
| 94:4-95:3 | 94:3-95:3 | 94:4-95:4 | 94:2-95:1 | 94:1-95:1 |
| 98:1-98:4 | | | 98:4-99:4 | 98:3-99:4 |
| 00:3-03:3 | 00:4-03:1 | 01:2-02:1 | 01:1-02:1 | 00:4-01:4 |
| 08:2- | 08:2-09:2 | 08:3- | 08:4-09:2 | 08:4- |

**Table 2: Recession Dates**

To further interpret these findings, we briefly recount that the process of stabilization and reform that Mexico experienced in the 1980's. Increases in inflation and public deficits in Mexico date from the early 1970's. Despite a partial stabilization in 1977, the discovery of oil in 1978 led to a repeat of the policies of the previous period, with an increase in public sector expenditure from 29.5% of GDP in 1977 to 41.3% in 1981, an overvaluation of the peso, and the subsequent resurgence of inflation, balance of payments problems, and a large foreign debt. These factors led to the 1982 Mexican debt crisis and its aftermath. During this period, the Mexican government began a program of stabilization and reform, which succeeded after 1988 in bringing down inflation and increasing real economic growth. The stabilization plan launched at the end of 1987 included trade liberalization, privatization of public enterprises, fiscal reform, and the deregulation and liberalization of the financial sector. See Rogers and Wang (1995). Prior to 1988, the Mexican inflation rate ranged between 20% to 180%, and real per capita GDP growth fluctuated from an average of 3.6% in the 1972-1981 period to -2.0% in 1981-1988 and 1.5% during 1988-1992. The business cycle dating that we provide is essentially consistent with these observations, as it lists the pre-1986 era in terms of recessions or contractions and the post-1986 era as an expansion. The low growth rate of output during expansionary period of 1988-1992 for Mexico may also explain our findings in Table 1, which assign an average growth rate of 3.3% during expansions.

To understand the findings for Turkey, we note that Turkey essentially experiences expansions that are shorter than those for Mexico. However, unlike the experience of Mexico, the growth rate of output during expansions for Turkey is over 6.5%.[7] As many commentators have noted, the Turkish economy was characterized by high inflation and large fiscal deficits in the period prior to 2002. Inflation increased after the oil shocks of 1973-1975, and remained high for nearly 30 years. During the same period, Turkey was witness to a series of financial liberalizations measures such as the lifting of ceilings on loan and deposit rates, the reduction of reserve requirements on deposits, and a decrease in taxes on financial transactions. The Turkish financial system was essentially opened to the rest of the world with the liberalization of foreign exchange operations and international capital movements in 1989 (as well as the establishment of convertibility of the lira). During this period, various measures of financial market development rose strongly (see Atiyas and Ersel, 1994). However, the period in ques-

7 The differences between output growth for Mexico and Turkey during expansions is mitigated somewhat when we consider that there is a positive trend in output growth for the former and a negative trend for the latter over the sample period.

tion was witness to the extremely high and increasing level of public sector borrowing requirements. While these averaged only 7.1% of GDP over the 1985-1990 period, they increased to 9.5% of GDP in the five years after 1990.

These developments were accompanied by a boom-bust scenario that continued until the crisis of 2000-2001, after which a series of institutional and policy changes at the domestic level were successful in lowering inflation by maintaining fiscal credibility. These measures also led to the renewed soundness and health of the Turkish banking system. However, prior to 2002, Turkey experienced high inflation and volatile economic growth. Diboğlu and Kibritçioğlu (2004) study the determinants of inflation and output growth shocks using a structural VAR and find that terms of trade shocks have a significant effect on inflation in the short run while in the long-run monetary and balance of payment shocks dominate. Furthermore, they find that output is driven by terms of trade and supply shocks. Their results point to the importance of a credible disinflation program and structural reforms to restrain discretionary fiscal spending. Ozatay and Sak (2002) present a comprehensive discussion of the factors that led to the crisis of 2000-2001 and contrast it with the financial crisis of 1994. While the crisis of 2000-2001 erupted in the midst of an IMF-sponsored exchange rate-based stabilization plan, the 1994 crisis occurred under a managed exchange rate float. As many authors have noted, one of the main differences between the 1994 and 2000-2001 crises was the presence of banking sector fragility and self-fulfilling prophecies in the latter.

When we view the recessionary experiences of Mexico and Turkey further, we observe recessions during 1998-1999 as well as the period beginning in 2000. We already discussed the 2000-2001 crisis in Turkey; for Mexico, the period 2000-2003 corresponds to a growth slowdown and recession that mirrors the bursting of the dot com bubble in the US and the ensuing recession in developed countries. However, we also observe recessions during 1998-1999, which are related to the Russian crisis of 1998. When we view the crises in developing economies such as Mexico and Turkey, it is useful to recall the comments of John Taylor (2007) on the Uruguayan crisis of 2002. He asks whether the period beginning with the crisis of 1994-1995 in Mexico and ending with the Uruguayan crisis of 2002 should be viewed as “8 years of crises or one 8-year crisis”. His comments are directed at the issue of contagion of emerging market crises and also the measures taken by such economies to overcome them. Calomiris (1999) discusses the factors that led to large spillovers from the 1994-1995

Mexican crisis or the "Tequila" crisis to countries such as Argentina and Brazil, and argues that one important reason may have been "history", or more precisely, the fact that reforms in Argentina and Brazil were largely untested in an environment where economic players still had vivid memories of coinciding crises in these countries dating to the 1980's. Such effects were also evident during the Russian crisis of 1998, which also affected a number of emerging market economies, including Brazil in 1998 and ultimately, Argentina beginning in 1999. By contrast, no significant contagious effects were witnessed during the Argentine crisis and sovereign debt default of 2001-2002, partly due to policy measures to overcome such contagion.

Another important set of events that has affected the cyclical performance of countries such as Mexico and Turkey lie in the regional trade agreements that these countries entered into during the 1990's. The North American Free Trade Agreement (NAFTA) signed between Canada, USA and Mexico clearly constitutes an important turning point for the Mexican economy. This agreement not only covered merchandise trade but it was also related to issues of investment, labor markets and environmental policies. As a result of this agreement, increase in trade and financial flows among NAFTA partners were stimulated and NAFTA contributed to making North America one of the most economically integrated regions in the world. This increase in regional integration among NAFTA partners also affected business cycles in Mexico and a significant increase in the co-movement of business cycles within the NAFTA region occurred. As Köse, Meredith and Towe (2004) recount, the role of country-specific shocks driving the Mexican business cycles declined and the role of region-wide shocks increased. NAFTA also had favorable effect on Mexico's growth performance and over the past decade investment in GDP growth and total factor productivity increased sharply. The increased synchronization between Mexico's business cycles and those of its partners in NAFTA is also studied by De Pace (2010).

Yılmaz (2010) studies the impact of entering into a Customs Union (CU) with the European Union in 1996. He argues that the existence of the Customs Union helped to improve productivity in Turkish manufacturing industries as well improving the implementation of competition policy. However, the economic and political uncertainty in the Turkish economy during the 1990's as well as the lack of structural reforms failed to yield the foreign direct investment flows that has been expected as a result of this agreement. Nevertheless, its increased productivity and competitiveness contributed to

the ability of Turkish industry to weather the crisis of 2000-2001 and also to withstand the entry of China into world export markets. However, Yılmaz (2010) argues that in the absence of full membership into the EU following the CU, Turkey would gain more flexibility in its trade policy and thus ease the competitive pressure on its exporters if the CU is replaced by a free-trade agreement (FTA) with the EU.

There are few studies that have examined the cyclical characteristics of the Turkish economy in the post-2002 period. Altuğ, Tan and Gencer (2010) examine the cyclical dynamics of industrial production and employment for a group of developed and developing countries. Their approach involves fitting univariate and composite Markov chains to these series. They test both for the invariance of homogeneity of the fitted Markov chain over the sample period in question and also for its order. This is contrast to the Markov switching model, which does not test for changes in the probability transition matrix for the underlying Markov switching variables, or the BBQ algorithm, which is silent on the data generating process in the first place. These authors find that a break point can be identified for Mexican industrial production growth in 1995 corresponding to the signing of NAFTA, and a second break for Mexican employment growth in 2000, indicating that the nature of the processes estimated before and after these breakpoints are significantly different from each other. Likewise, they find that the processes for industrial production and employment growth for Turkey differ significantly from each when the years 2000 and 2002 are taken as the respective breakpoints. Furthermore, they find that the estimated processes in the post-breakpoint period tend to be less persistent relative to the estimated processes in the earlier period. Finally, they find that the composite indicator constructed by combining information on both industrial production and employment growth for Mexico and Turkey tend to significantly different than those for other developed and developing economies, providing further evidence on the similarity of the cyclical dynamics for these countries during the last decade.

## Conclusion

In this paper, we have examined the nature of business cycles in two developing economies, Mexico and Turkey, from the late 1980's to the present. Though sharing little geographical or historical proximity, our results indicate that there are a number of common features of business cycles in these two countries. We find that output

growth has tended to be higher but more volatile in Turkey than in Mexico. We also find evidence for factors that led to recurring crises in these countries and to subsequent reform.

We note that Mexico implemented structural reforms that curbed its fiscal deficits and lowered its inflation earlier than Turkey. However, it has not benefited from unimpeded high growth in the aftermath of these reforms.[8]Likewise, Turkey finally succeeded in its program of disinflation and fiscal sustainability implemented after the crisis of 2000-2001, but its record of growth in its aftermath has not been without its critics.[9] Finally, we provide some evidence that there is considerable similarity in the cyclical dynamics of some key macroeconomic variables for Mexico and Turkey in the post-2000 period, suggesting the role of changing global and local factors on these economies.

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# Can Turkish Recessions Be Predicted?

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## 1. Introduction

There is much skepticism about the ability to predict recessions. Harding and Pagan (2010b) have argued that this is because the definition of a recession involves the signs of future growth rates of economic activity and there is little predictability of these from the past. Turkey represents an interesting case study since growth in Turkish GDP features quite high serial correlation, suggesting that growth itself is predictable. Thus I want to examine whether it is possible to predict recessions in Turkey. As there seems only a small published literature on this it will be necessary to indicate what definition of recession is to be used and what information might be available to make a prediction of such an event.

In section 2 a definition of a recession is given that revolves around isolating peaks and troughs in a series that represents economic activity. Although the presentation will concentrate upon quarterly data it can be extended to monthly series, although there is little to be gained from doing so for an understanding of the prediction issues. Section 3 then uses that definition to examine whether there is some predictability for recessions in Turkey using various sets of information. These sets are constructed in a number of ways. Firstly, in order to establish the basic themes of the paper, only information on the growth rates in activity is used. This turns out to provide little that can be exploited for recession prediction. Secondly, a small linear dynamic model of the Turkish economy is constructed and used to make recession predictions. Although the latter improves the prediction record when compared to the situation when only growth information is used, it is only marginally better, except for the last recession.

Finally, we ask whether a non-linear dynamic model - a Markov Switching model of Turkish growth - might be more efficacious, but find in the negative.

It might have been anticipated that neither the linear nor non-linear models would prove particularly useful for the predictive task, since they only utilize information on past events, and any major improvement in predictive efficacy is likely to require the application of series capturing the future shocks affecting the economy. In the US and Euro area there are quite a few series that have been suggested for this purpose e.g. the term structure of interest rates, indices such as the Business Conditions Index published by the Federal Reserve Bank of Philadelphia - Aruoba et al (2009) - and the Euro-Sting model indicators set out in Camacho and Perez-Quiros (2010). Such data does not seem to be readily available in Turkey. We experiment with the US and Euro-Area indicators to see if they might provide some useful information about recessions in the Turkish economy, in the event that these are connected with a global downturn. We also canvass the use of an index of capacity utilization which has appeared in regressions explaining Turkish GDP growth. There may be other series that could be used for this purpose but they do not seem to be readily available. It would probably be useful if whatever indicators are available were gathered and made accessible for macroeconomic research on business cycles.

## 2. Recognizing a Recession

Figure 1 shows the log of seasonally adjusted Turkish quarterly real GDP, $y_t$, over the period 1987:4 to 2010:1.[1] The six recessions and the point they are at in the graph are 1988:4-1989:2 (5), 1991:1-1991:2 (14), 1994:2-1995:1 (27), 1998:4-1999:4 (45), 2000:1-2001:4 (54) and 2008:4-2009:3 (85). For graphical purposes the data has been mean corrected and .4 added on so as to keep the series between zero and unity. There are six obvious recessions. The one between 1990:4 and 1991:2 is the least striking. Figure 2 shows that it was a shallow recession and one in which there was not a smooth rise from the trough in 1991:2.

1 With $y_t$ being the log of GDP the data used in our analysis is the average $(y_t+y_{t-1}+y_{t-2}+y_{t-3})/4$ which is known to eliminate an evolving seasonal pattern. Other methods of seasonal adjustment such as X11-ARIMA might be employed but this method is simple and isolates the business cycle quite well.

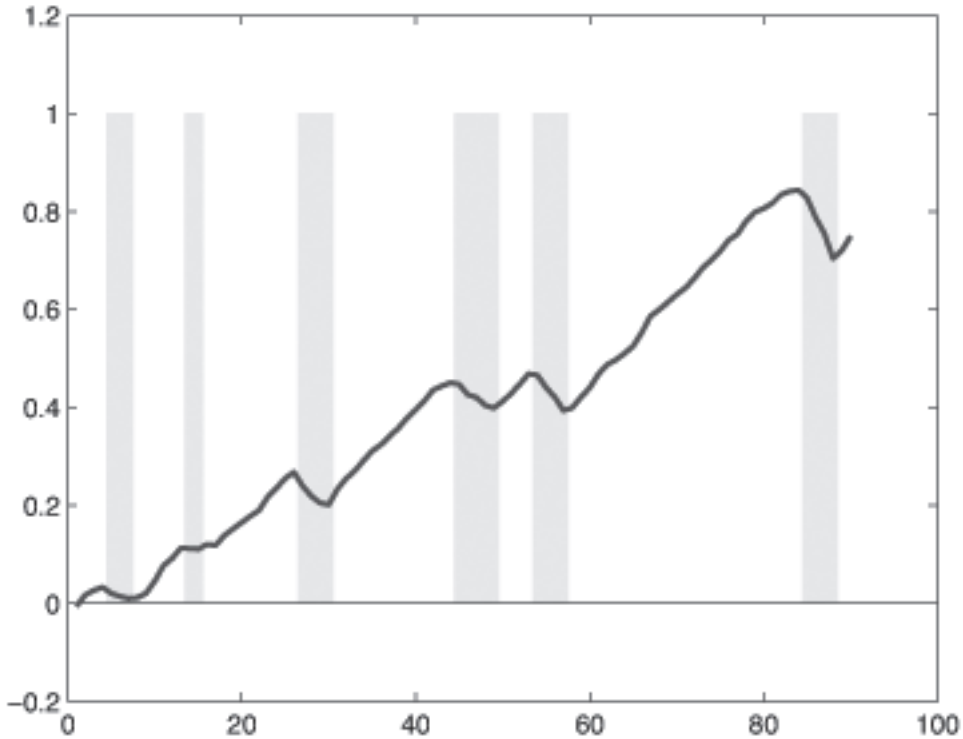


Figure 1: S.A. log GDP and Recession Periods for Turkey, 1987:4-2010:1

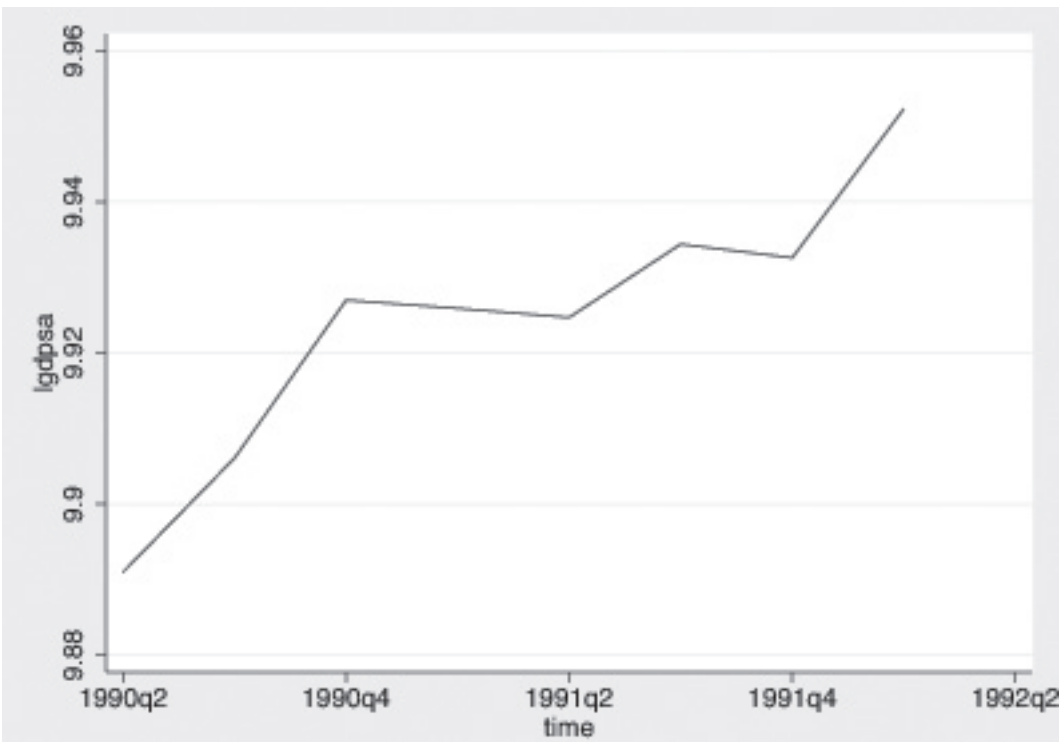


Figure 2: The Early 1990s Recession and Expansion

Now, rather than look at the pictures to decide where the turning points are, we can automate the process of selecting them. A *peak* marks the end of an expansion and a trough the end of a recession. A program that we use to date quarterly series like this is the BBQ program.[2] BBQ derives from the principles set out in Bry and Boschan (1983) and underlies much of the NBER business cycle dating philosophy. It is a WYSIWYG program, as evidenced by putting the turning points identified by BBQ on the graph of the log of Turkish GDP - see Figure 1 where the grey areas are BBQ-defined recession periods. Note that the shallow recession we have just mentioned was identified by BBQ. Indeed, following our standard strategy, BBQ was run on this data first and then the outcomes identified by the program were visually verified. So the first point to make is that BBQ isolates turning points in a series representing economic activity. It is worth noting that we could have just used the original GDP data rather than the log of it to locate the turning points. They are the same in both series due to log being a monotonic transformation. It is more instructive to work with the log of GDP, as the changes in that series are approximately growth rates. Given the fact that BBQ reliably finds turning points we can think more formally about how one detects a recession by looking at the rules that are written into BBQ.

The basic rules that BBQ uses to locate a set of turning points are as follows.

1. A *peak* occurs at time t if $y_t$ is greater than $\{y_{t-1}, y_{t-2}, y_{t+1}, y_{t+2}\}$ -Thus 2000:4 is a peak since the values in $\{y_{2000:2}, y_{2000:3}, y_{2000:4}, y_{2001:1}, y_{2001:2}\}$ are {10.2432, 10.2621, 10.2826, 10.2801, 10.2543}. Why choose two quarters on either side of the potential peak? The reason is the feeling that a recession (time between peak and a trough) should last for some minimal time, otherwise recessions will be called too often. By convention this has become 2 quarters ( or five months if one uses monthly data).[3] This could be changed if one wished. For Turkey it would matter only a little if one moved to one quarter as the minimum length of a recession, since there is just one period of negative growth in what one would most likely think of as an expansion phase (1991:4, see Figure 2). In countries such as the US and Australia it would matter a lot, as these often have a single quarter of negative growth in expansions. The point is that a recession is an unusual event, and so some convention needs to be established about how such behaviour in GDP is to be recognized. One might also apply some quantitative rules e.g. the decline in GDP has to be larger than some specified value.

2 Available at http://www.ncer.edu.au/data/

3 The NBER Dating Committee uses the five monthly rule when finding the turning points in the US economy.

This might be used to eliminate the recession of 1990:4-1991:2 in Turkey but, although this is sometimes done informally, it is not common. It should be noted that the BBQ rule does not coincide with that often used in the press that a recession is two consecutive periods of negative growth. Nor does it replicate rules that sometimes appear in the academic literature e.g. Fair (1993) has a recession occurring in time t if there are two consecutive negative growth rates in GDP in the five quarters that begin in t.

2. There are other constraints that BBQ uses such as a minimal length for a complete cycle i.e. the period from a peak to the next peak, but these are of smaller importance and won't detain us here.

3. Once the turning points have been isolated it is possible to determine where recessions and expansions occurred. It is convenient to summarize this information by constructing a series $S_t$ that takes the value unity when we are in an expansion and zero when we are in recession. Thus, when we are concerned with predicting a recession at time t + 1 we will be asking what the chance is that $S_{t+1} = 0$. It will also be convenient to define $R_t = 1 - S_t$ as then $R_t = 1$ indicates a recession.

4. The condition for a peak can be expressed in terms of growth rates in economic activity. When that is done a peak at t occurs when $\{\Delta y_t > 0, \Delta_2 y_t > 0, \Delta y_{t+1} < 0, \Delta_2 y_{t+2} < 0\}$, where $\Delta_2 y_t = y_t - y_{t-2} = \Delta y_t + \Delta y_{t-1}$ is six-monthly growth. Another way of expressing this is to adopt the conventional definition that a recession starts the period after a peak while an expansion begins the period after a trough - see Estrella and Trubin (2006). Using that perspective we can alternatively express a turning point as a change in state viz. $S_t = 1 \rightarrow S_{t+1} = 0$ if there is a peak at t. Thus, if $\{\Delta y_t > 0, \Delta_2 y_t > 0, \Delta y_{t+1} < 0, \Delta_2 y_{t+2} < 0\}$, then there is a change from expansion to recession. If these conditions are not satisfied then we remain in the current state i.e. $S_t = 1 \rightarrow S_{t+1} = 1$. Thus to know if there has been a change in state we will need to know future outcomes and these are dependent on whether the events $\{\Delta y_{t+1} < 0, \Delta_2 y_{t+2} < 0\}$ occur.

As Harding and Pagan (2010b) observe the states $S_t$ are governed by a recursive relation

$$\begin{aligned} S_{t+1} &= S_t S_{t-1} [1 - \mathbf{1}(\Delta y_{t+1} \_ 0)\, \mathbf{1}(\Delta y_{t+1} + \Delta y_{t+2} \_ 0)] \\ &\quad + S_t (1 - S_{t-1}) \\ &\quad + (1 - S_t)(1 - S_{t-1})\, \mathbf{1}(\Delta y_{t+1} > 0)\, \mathbf{1}(\Delta y_{t+1} + \Delta y_{t+2} > 0), \end{aligned} \tag{1}$$

where **1** (*A*) = 1 if A is true and zero otherwise.[4] We wish to predict $S_{t+1}$ using the information available at t (designated by $F_t$). Then (1) points to the fact that any prediction of $S_{t+1}$ requires some values to be assigned to $\{S_t, S_{t-1}\}$, as well as the future signs of $\Delta y_{t+1}$ and $\{\Delta y_{t+1} + \Delta y_{t+2}\}$. As the latter depend upon the nature of the process generating $\Delta y_t$, it will be necessary to consider various candidates for this in the following sections. Notice however that it is the sign of $\Delta_{yt}$ that must be predicted rather than $\Delta y_t$ itself.

## 3 Predicting a Recession with GDP Growth Data

We are then interested in whether a recession can be predicted at time t + 1 using information available at t i.e. in predicting whether $S_{t+1} = 0$ (or $R_{t+1} = 1$). To make this concrete position ourselves at 2000:4 and ask whether there will be a recession in 2001:1. To perfectly predict $S_{2001:1}$ we need to know the sign of the GDP growth rates in 2001:1 and 2001:2. If the growth rates were independent then knowing these past values will be of no use in predicting the future growth rates *per se*. Now in many countries there is very little persistence in growth rates of GDP e.g. the UK and Australia. But in Turkey there is quite strong first order serial correlation in growth rates of the order of .7. *Prima facie* this might look advantageous but we will see later that it is not.

Suppose we know that $S_t = 1$ and $S_{t-1} = 1$. From (1) the probability of a recession given that we are in an expansion at t and some information $F_t$ will be

$$\Pr(R_{t+1} = 0 \mid F_t) = \mathrm{E}\{\mathbf{1}\,(\Delta y_{t+1} \le 0)\ \mathbf{1}\,(\Delta y_{t+1} + \Delta y_{t+2} \le 0) \mid F_t\}$$

$$= g(F_t).$$

The functional relation $g(.)$ will generally be non-linear for two reasons. One is that the conditional expectations will be non-linear in $F_t$ as they must lie between zero and unity, but it also may be that $\Delta y_{t+j}$ $(j = 1, 2)$ depends in a non-linear way upon $F_t$. In most instances $g(.)$ will not be analytically derivable. If the number of elements in $F_t$ is limited then one can use non-parametric methods to estimate $g(.)$ as in Harding and Pagan (2010a). Unlike that paper it is important to make the $g(.)$ function monotonic,

4 There is a small complication caused by completed cycles having a minimum duration of five quarters. Only occasionally does this constraint bite.

given that it is a probability, and Harding (2010) shows how one can adjust the non-parametric estimates to impose monotonicity in a reasonably simple way.

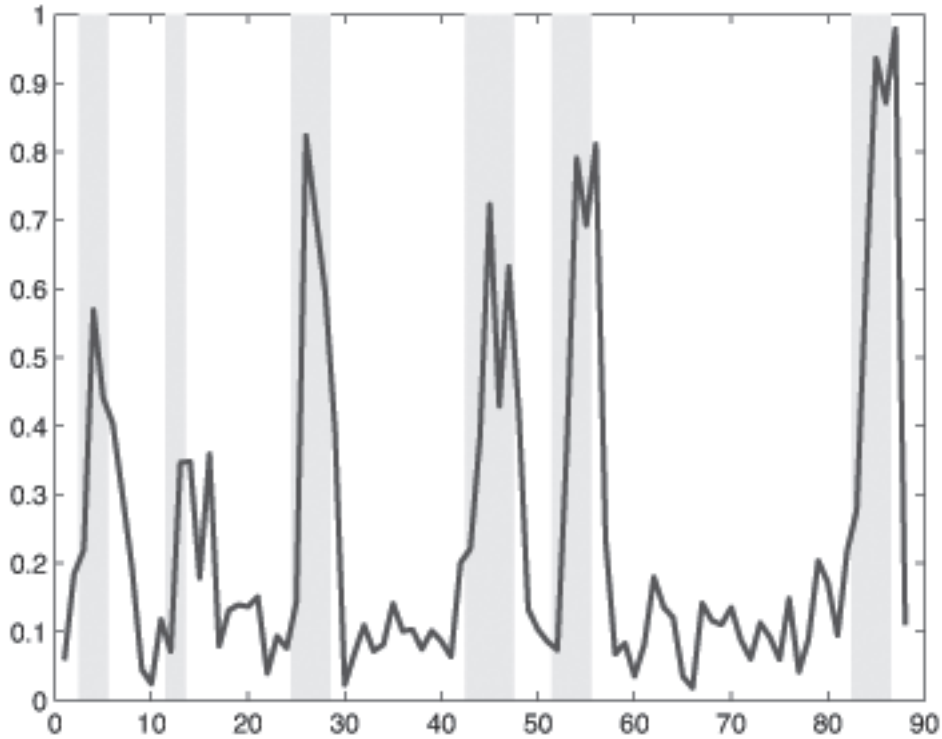


Figure 3: Probability of Recession Conditioned on GDP Growth in Previous Quarter

Figure 3 shows $\Pr(R_{t+1} | \Delta y_t)$ from 1987:4 to 2010:1 i.e. $F_t = \Delta y_t$, while Table 1 focuses upon these predicted probabilities during the 2001 recession.[5]

| Table 1 : Probabilities of Predicting the Turkish 2001 Recession | | | |
|---|---|---|---|
| Prediction At $t$/For $t+1$ | $\Pr(R_{t+1} = 1 \mid \Delta y_t)$ | | $R_{t+1}$ |
| 2000:4/2001:1 | .06 | | 1 |
| 2001:1/2001:2 | .55 | | 1 |
| 2001:2/2001:3 | .94 | | 1 |
| 2001:3/2001:4 | .82 | | 1 |
| 2001:4/2002:1 | .94 | | 0 |

5 Although we will write $\Delta y_t, s_{t-1}$ etc. as the available information we will mean all the past values of these quantities.

This is a typical pattern - the first period of the recession is predicted with very low probability, but it then rises as the recession gets underway. Thus at the time the recession emerges i.e. $S_{t+1} = 0$, we would have prediction probabilities for the various Turkish recessions of .22 (1988:4), .07 (1991:1), .14 (1994:2), .22 (1998:4), .07 (2001:1) and .28 (2008:4). If we think that a critical value here is .5 (a fairly common choice) then none of the six recessions would have been predicted using current GDP growth.[6] To put these numbers into context, since 24% of the time was spent in recession over 1987-2010, if you just allocated a value of .24 every period you would almost always do better than trying to exploit the information available on growth rates - the single exception being for the last recession.

As mentioned before an important element in recession prediction is the ability to predict negative growth i.e. a high value of $\Pr(\Delta y_{t+1} \leq 0 \mid F_t)$ is desirable. Now, if $F_t = \Delta y_t$, the fact that there is strong positive serial correlation in GDP growth in Turkey militates against successfully predicting $\Delta y_{t+1} < 0$, since a positive growth in the previous period points towards it being positive again. Indeed, the correlation of $\psi_t = 1(\Delta y_{t+1} < 0)$ with $\psi_{t-1}$ is .59.[7] Hence it is very difficult to predict negative growth coming out of an expansion. Only after the recession has arrived will the strong dependence in $\Delta y_t$ make the probability of $\Delta y_{t+1} < 0$ substantial. A non-parametric estimate of the $\Pr(\Delta y_{t+1} < 0 \mid \Delta y_t)$ shows that for small positive growth rates in GDP the probability is around .4, and so less than the critical value of .5.[8] Thus, even if there is close to zero growth at t, we would still not attach a high probability to negative growth in the next period.

In practice it is unlikely that the information available to predict recessions would be current period GDP growth ($\Delta y_t$) due to the lags in assembling national income data. In Australia the most we could hope for is $\Delta y_{t-1}$. Even then this quantity can be subject to substantial revision, and even a possible sign change. This has two consequences. One is that it will no longer be the case that we would know $S_t$ i.e. whether we are in an expansion or a recession when the prediction needs to be made. If it was the case that $S_{t-1}$ was known to be unity, then a positive $\Delta y_t$ would mean that $S_t = 1$, since the peak in $y_t$ would not be at t – 1. But if we don't know $\Delta y_t$ then it might be negative.

6 The issue of deciding on a threshold is a difficult one. The choice raises similar issues to balancing Type 1 and Type 2 errors in hypothesis testing.

7 Under a normality assumption for $\Delta y_t$ Kedem(1980) gave an expression for the serial correlation coefficients of $1(\Delta y_{t+1} > 0)$ in terms of the serial correlation coefficients of $\Delta y_t$.

8 The probability is identical to $E(1(\Delta y_{t+1} < 0) \mid \Delta y_t)$ given the binary nature of the event $1(\Delta y_{t+1} < 0)$ so we can estimate the probability with a non-parametric estimate of the conditional mean of $1(\Delta y_{t+1} < 0)$.

Since a negative growth can occur in an expansion, $S_t$ could be either 0 or 1, and so we will need to predict this, as well as $\Delta y_{t+j}$ (j = 1, 2). This problem of trying to come up with the latest GDP growth outcome is often referred to as "now-casting".

## 4 Predicting Recessions: Using a Small Structural VAR to Predict GDP Growth

In an attempt to expand the information set used to perform the predictions we need to build models for $\Delta y_t$. To this end a small structural Vector Autoregression (SVAR) model was fitted to Turkish data from 1990:3 until 2010:1.[9] The length of sample was determined by the availability of a short run interest rate ($i_t$). The variables fitted were the logs of exports ($x_t$), GDP ($y_t$), Gross National Expenditure ($n_t$) - "absorption" in international economic models - CPI inflation ($\pi_t$) and the real exchange rate ($q_t$). The model is a smaller version of that used by Dungey and Pagan (2000) for Australia, and has close connections with that used in Catao and Pagan(2010) when modeling Brazil and Chile. In the latter paper a model based on a typical New Keynesian model for an open economy was augmented with extra variables if the data supported such additions. Here we do not have the forward looking expectations in equations that appeared in Catao and Pagan (2010). For our purpose this did not seem necessary as the expectations are always replaced with observable variables and so would show up as extra regressors if required. The equations can then essentially be solved to determine a data generating process for $\Delta y_t$.

A few comments on the SVAR equations in (2)-(8) are in order. First, variables with a tilde are deviations from a fitted deterministic trend and so can be regarded as "gaps". The trends are much the same for GDP and GNE but that for exports is almost twice as large. Exports typically grow faster than GDP for many countries and this is handled in the trade literature using gravity models. Some of this disparate behaviour comes about due to the removal of trade barriers. As these are largely exogenous to the economic outcomes of the country being examined, we simply allow the trend growth in exports to be higher than GDP. A second order SVAR was taken to be the reference point, reflecting the fact that many New Keynesian models imply a VAR(2) as their solved solution. The data strongly supports this for some equations. If the second lags of variables were not significant they were deleted.

9 Sometimes the sample started at 1990:4 and ended at 2009:4, depending on the lags and data availability.

Both exports and GNE seemed to have a seasonal pattern, and thus these series were smoothed by a fourth order moving average, just as for GDP. After this seasonal adjustment, the exports, GNE and GDP data were converted to percent deviations. Data for interest rates and inflation have been converted to annual percentages and the log of the real exchange rate was multiplied by 400 to be consistent with these units.

Because the model is recursive OLS was applied to estimate the coefficients. Equations (2)-(8) provide the estimated coefficients with the absolute values of the t ratios below the coefficients The $\varepsilon^{i}_{t}$ have standard deviation of unity and so the scalar multiplying them is the standard deviation of the shock. The shocks were generally uncorrelated; the exception being those associated with the real exchange rate and GNE equations. Hence one cannot separately interpret those shocks.

$$x_t = 1.55x_{t-1} - 0.56x_{t-2} - 0.007q_{t-1} + 1.86\varepsilon_t^{x} \quad (2)$$
(15.8) (5.5) (2.2)

$$n_t = 1.67n_{t-1} - 0.78n_{t-2} - 0.013rr_{t-1} + 1.98\varepsilon_t^{n} \quad (3)$$
(21.1) (9.5) (0.9)

$$y_t = 0.86y_{t-1} - 0.07y_{t-2} + 0.53n_t - 0.41n_{t-1} - 0.001q_{t-1} + 0.022x_t + 0.46\varepsilon_t^{y} \quad (4)$$
(11.9) (1.6) (22.0) (10) (1.5) (3.7)

$$\pi_t = 1.33\, y_t - 0.27q_{t-1} + 16.4\varepsilon_t^{\pi} \quad (5)$$
(3.5) (11.3)

$$i_t = 0.77\, i_{t-1} + 0.14\pi_t + 0.09y_t - 0.03q_{t-1} + 7.1\varepsilon_t^{i} \quad (6)$$
(12.4) (2.7) (0.6) (1.5)

$$q_t = 0.8\, q_{t-1} + 0.44(rr_t - rr^{*}_{t}) - 0.46\pi_{t-1} + 27.7\varepsilon_t^{q} \quad (7)$$
(12.3) (2.4) (2.4)

$$rr_t = i_t - \pi_t \quad (8)$$

Exports are viewed as being affected by the real exchange rate but also growing with some exogenous world trade variable that is not specified. Thus the export shock can be interpreted as the deviation of world trade from a constant growth path. The absorption equation is motivated by the conventional Euler equation for consumption, where the real rate of interest affects expenditure decisions, but it is entered with a lag

to reflect institutional realities. The GDP equation reflects the split up of expenditure into domestic and external components. The shock here could be regarded as a preference shock between foreign and domestic goods. Inflation responds to the output gap and the exchange rate. The latter is highly significant and parallels what was found for Chile and Brazil in Catào and Pagan (2010). An interest rate rule is used and it exhibits a dependence on the output gap, inflation and the real exchange rate. The last variable was used by Alp and Elekdag (2010) in their work, although here the evidence for it is much weaker. Finally the real exchange rate responds to the real interest rate differential (the real interest rate based on three month Treasury Bills for the US was taken to be the foreign real rate) but there also seemed to be a negative effect from lagged inflation. We note that the coefficient on the real interest differential is just half of what one might expect from uncovered interest parity, although one cannot make such a simple comparison without having some measure of exchange rate expectations.

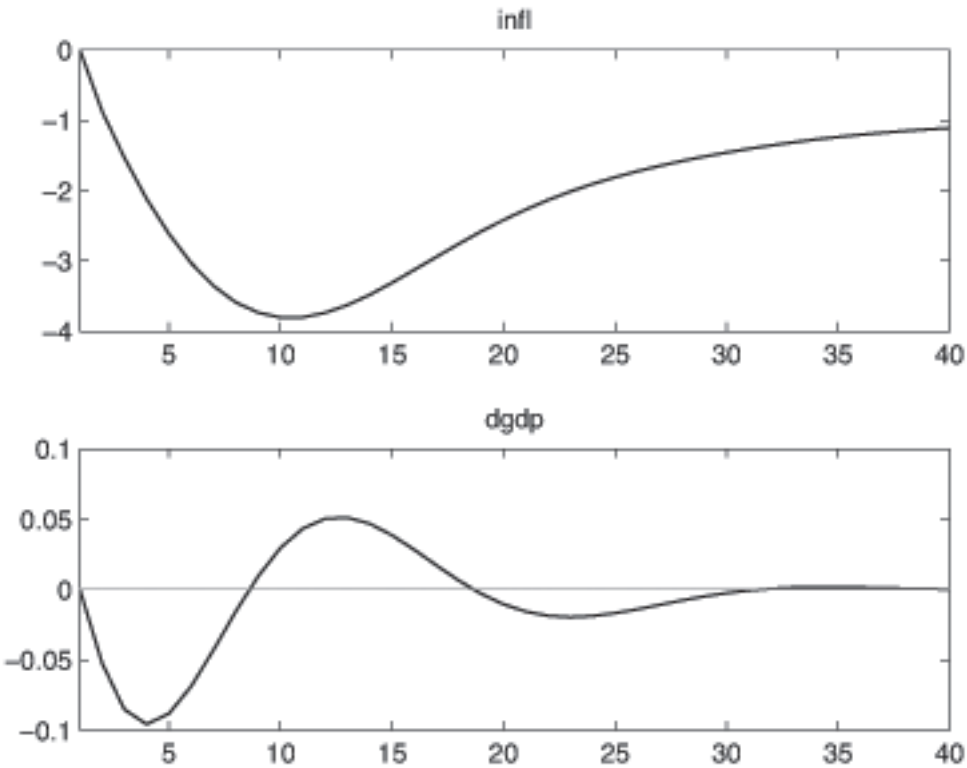


Figure 4: Monetary Impulses for Annual Inflation and Quarterly GDP Growth for the Turkish SVAR

Figure 4 shows the impulse responses of annual inflation (infl) and quarterly GDP growth (dgdp) to a one standard deviation interest rate shock. One standard deviation is quite large, around 700 basis points. It is therefore apparent that monetary policy

does not have strong effects upon GDP growth but it does have strong effects on inflation, and these come through the exchange rate. This is similar to what was found by Catao and Pagan for Brazil and Chile. Simulating the SVAR model results in an average duration of recessions and expansions of 4.6 and 10.7 quarters respectively. For the period since 1987 the averages in the data for the six complete cycles were 3.7 and 11.3, so the match is reasonable.

Now there are quite a few variables in the SVAR that could be used as $F_t$. It seems efficient that one utilize $E(\Delta y_{t+1} \mid F_t)$ from the SVAR model as an explanatory variable in the Probit model for $R_t$. Given the estimated parameters of the SVAR above we find that[10]

$$E(\Delta y_{t+1} \mid F_t) = 0.034x_t - 0.14y_t + 0.475n_t - 0.0069rr_t - 0.0012q_t$$
$$- 0.012x_{t-1} - 0.07y_{t-1} - 0.413n_{t-1}$$

Using this for $F_t$ the probabilities of a recession from the Probit model are given in Figure 5. As a simple summary it is once again useful to look at the first period probability of a recession and these are {.07, .26, .39, .03, .65}, which are superior to those which used growth in GDP viz {.07,.14,.22,.07,.28}.[11] So the SVAR model does provide a set of variables that improve on the predictive power, particularly for the last recession. Nevertheless, one should be careful about this apparent success, as it is unlikely that variables such as $n_t$ and $y_t$ would be available to make a prediction, just as $\Delta y_t$ was not, although variables such as $rr_t$ and $q_t$ might well be. Indeed, if we assume that only lagged information is available, the prediction probabilities decline. So the .39 for the 1998/9 recession becomes .29 and the last recession becomes .42. Again this implies that a good now-cast of absorption, GDP and exports is needed.

10 Ideally one would evaluate $\Pr(R_{t+1} \mid F_t)$ using the formula (1). This can be done by simulating the SVAR model and computing the required expectations non-parametrically.

11 The 1988:4-1989:2 recession is not included as there was no data on $rr_t$

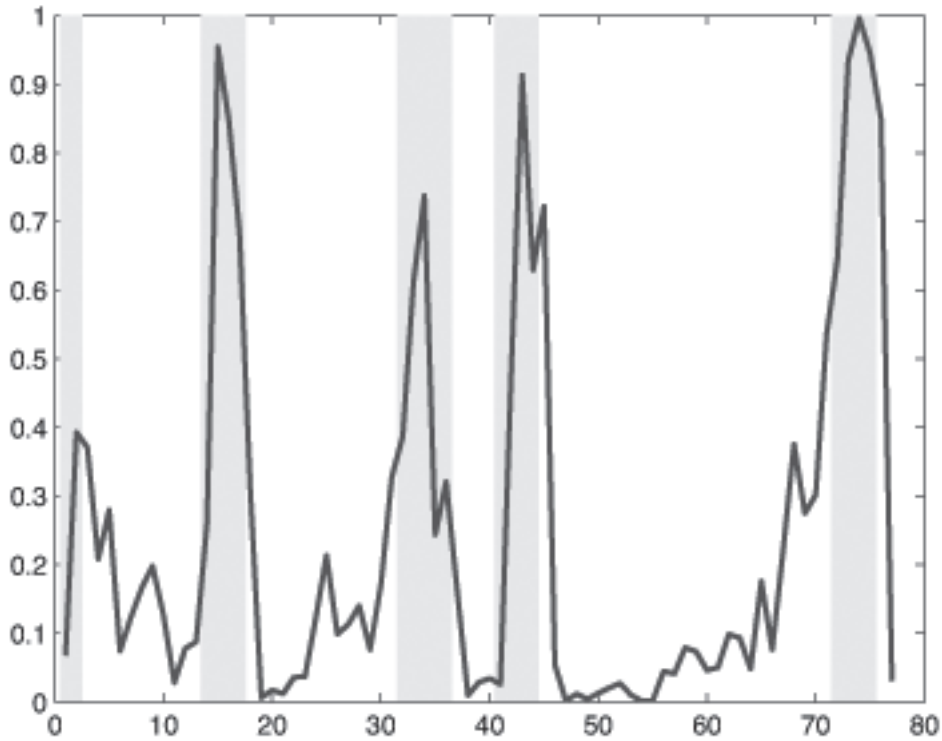


Figure 5: Probabilty of Recession Conditioned upon Expected Valne of Growth from SVAR Model

# 5 Can Non-linear Models of GDP Growth Help?

The previous section drew attention to studying $\Pr(\Delta y_{t+1} < 0 \mid F_t)$ as a first test of the ability to predict a recession. So far we have assumed that there is effectively a linear model connecting $\Delta y_t$ and past values of GDP growth as well as other variables ( in the SVAR case). One might allow $\Delta y_t$ to also depend upon the state of the economy at *t-j,* $S_{t-j}$, as this is often mentioned as a possibility. Of course, since $S_{t-j}$ depends on growth rates in GDP, one could assert that all that is needed is observable growth rates. But this ignores the fact that *St* is a parsimonious summary of these, and that it also introduces some non-linear structure through the fact that *St* depends on the sign of the growth rate and not the magnitude. Fitting a Probit model to $1(\Delta y_{t+1} < 0)$, with explanatory variables $\Delta y_t$ and $S_t$ suggests that there is little separate influence of $S_t$.

An alternative modification is to allow growth in economic activity to be a non-linear function of past growth. Many non-linear models for $\Delta y_t$ have been proposed, and often one sees comments that these produce better forecasts of GDP growth than linear models. A popular one that is used in a lot of the business cycle literature is that

of a Hidden Layer Markov Chain, introduced into econometrics by Hamilton (1979). This is often given the shortened descriptor of a Markov Switching (MS) model, with the simplest variant having the form,

$$\Delta y_t = \mu_t + \beta \Delta y_{t-1} + \sigma \varepsilon_t \tag{9}$$

$$\mu_t = \mu_1 \xi_t + (1 - \xi_t)\mu_0 \tag{10}$$

$$p_{ij} = \Pr(\xi_t = i \mid \xi_{t-1} = j). \tag{11}$$

where $\xi_t$ is a binary random variable that follows a first order Markov process with transition probabilities $p_{ij}$ and $e_t$ is $n.i.d(0,1)$. More complicated models are available but we doubt that these improve the recession predictions -see for example the discussion in Engel et al (2005). The MS model in (9) — (11) was estimated for Turkey using data from 1988:1-2008:4, producing the results in Table 2.[12]

**Table 2 Estimated Parameters of MS Model for Turkey**

| | est | t |
|---|---|---|
| $\beta$ | 0.275 | 2.5 |
| $\mu_1$ | 1.215 | 4.2 |
| $\mu_0$ | 0.013 | -2.4 |
| $p_{11}$ | 0.92 | 5.1 |
| $p_{01}$ | 0.26 | 2.0 |
| $p_{10}$ | 0.08 | 2.0 |
| $p_{00}$ | 0.74 | 1.8 |
| $\sigma^2$ | 0.625 | 5.4 |

The probability of getting $\Delta y_{t+1} < 0$ given $\Delta y_t$ from this model was found by simulation to be .36 for small positive values of $\Delta y_t$. Thus there is actually a smaller probability of getting a negative growth rate at t + 1 than what would have been found from a model in which growth just depended linearly on past growth. It may be that the MS model gives a better fit to the data but it produces a worse record at predicting recessions.

12 The package used for estimation was Perlin (2009).

# 6. Predicting Recessions: Indicators of Future Growth

So far we have looked at whether one can predict recessions with the past history of macroeconomic variables and found that this is not likely. The fact that we are looking for the shocks that cause movements in future growth suggests that greater success might be had by concentrating upon variables that contain some forward-looking information. A number of these have been suggested for the US and the Euro Area. In Harding and Pagan (2010b) the best predictor for U.S. recessions seemed to be the Business Conditions Index constructed by Aruoba et al (2009) ( ADS) and maintained by the Federal Reserve Bank of Philadelphia. This is introduced into a Probit model for Turkish recessions along with the SVAR model predictions constructed earlier. The t ratio for the ADS variable was around unity, so there was not much extra benefit to its use. Of course this index is available with shorter lags than most of the variables entering the SVAR. Still, even when only lagged information is used to construct the SVAR predictions, the ADS series fails to become significant.

The situation is better for two of the forward indicators of Euro Area growth - the Euro-Area Economic Sentiment Indicator (ESI) and the Germany IFO Business Climate Indicator (IFO). In this case, when added on to a Probit model featuring the SVAR predictions, one gets t ratios of 1.93 and 2.3 respectively. These t ratios rise to 2.5 and 2.1 if one recognizes that the SVAR predictor needs to be based on some lagged variables. Because the data we have available on the Euro Area indicators is limited it is difficult to affect a good comparison. The main difference to what the SVAR model would indicate is a higher probability of predicting the 1998/9 recession. This is somewhat odd as there was quite strong growth in the Euro Area at that time. Consequently, it might have been hard to explain any recession prediction that was based on the two forward indicators of Euro Area growth.

It would be ideal if one had some sentiment indicators for Turkey. I have not been able to find any with a substantial history. For Turkey Aysoy and Kipici (2005) give a GDP equation of the form[13]

13 They actually use $y_t^u - y_{t-4}^u$, where $y_t^u$ is seasonally unadjusted data, but, since we have $y_t = y_t^u + y_{t-1}^u + y_{t-2}^u + y_{t-3}^u$, it follows that $\Delta y_t = \Delta_4 y_t^u$.

$$\Delta y_t = a_1 \Delta y_{t-1} + a_2 r_t + a_3 \Delta_4 cps_{t-1} + a_4 \Delta_4 pcu_t,$$

where $r_t$ is the real Treasury Bill rate, $cps_t$ is total credit in real terms extended to the private sector, and $pcu_t$ is the private sector's capacity utilization rate. This suggests that one might use capacity utilization as an indicator. Again using the SVAR predictors as the benchmark, it was found that there is no advantage in adding on either the level of utilization or its growth rate. If one used the SVAR indicator constructed from lagged information then there was an improved prediction. Since it is likely that one would use the indicator information in now-casting GDP growth, it might be that this is a better interpretation of the increased predictive success.

## 7. Conclusion

We found that using information from past macroeconomic variables would result in only limited success in predicting Turkish recessions. Of course it may be that the SVAR model that we used could be improved by building in features that reflect financial factors and wealth effects, as in Alp and Elekdag (2010). It would be interesting to repeat our exercises with their model. Fundamentally however, the prediction of a recession requires some projection of future shocks, and for these one needs some forward-looking indicators. Finding these is difficult as there seems no readily available collection of them. Future research on Turkish macro-economic outcomes should attempt to build such indicators.

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