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and the rotation of
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BRETTON-WOODS SYSTEMS, OLD AND NEW, AND THE ROTATION OF EXCHANGE-RATE REGIMES

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Abstract

A recent contribution to the literature argues that the present international monetary system in many ways operates like the Bretton-Woods system. Asia is the new periphery of the system and pursues an export-led development strategy based on undervalued exchange rates and accumulated foreign reserves. The United States remains the centre country, pursuing a monetary-policy strategy that overlooks the exchange rate. Under both regimes the United States does not take external factors into account in conducting monetary policy while the periphery does take external factors into account. We provide results of a test of this hypothesis. Then, we present a new method for decomposition of a seasonally adjusted series the business cycle and other components using a time-varying-coefficient technique that allows us to test the relationship between the cycle and macroeconomic policies under both regimes.

Keywords: Revived Bretton-Woods system, asymmetry hypothesis, time-series, decomposition, time-varying-coefficient estimation

JEL classifications: C22, E32, F33

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1. Introduction

In a series of provocative articles, Dooley, Folkerts-Landau, and Garber (hereafter DFG) argue that the present constellation of global exchange-rate arrangements constitutes a revived Bretton-Woods, or Bretton-Woods II (BW2), system.¹ As was the situation under the earlier Bretton-Woods I system of the 1950s and the 1960s, DFG posit that the United States serves the role of asymmetric centre of the system, running balance-of-payments deficits, providing global (U.S. dollar) liquidity, and absorbing exports from the rest of the world. In the earlier Bretton-Woods system, Japan and the countries of Western Europe formed a periphery. The periphery maintained undervalued, pegged exchange rates and accumulated large amounts of U.S. dollar-denominated reserves in the pursuit of export-led growth. In the Bretton-Woods II regime, the countries of Asia, including Japan, largely fulfill the role of the periphery.² For countries such as China in the new periphery, the benefits of undervalued currencies exceed the costs of reserve accumulation. Moreover, accumulated reserves can be thought of as collateral held against inflows of foreign direct investment. The Bretton-Woods I system lasted for about a quarter of a century. DFG have argued that the present system, with its large global imbalances, will also be sustainable in the medium term.³

The idea that the international monetary system has evolved into a Bretton-Woods II system has generated two (sometimes-overlapping) strands of critical literature. One group of authors has accepted the general validity of the Bretton-Woods metaphor but points to substantial differences from the earlier Bretton-Woods system, differences that render the current regime structurally unstable.⁴ Roubini and Setser (2005), Roubini (2006) and Hunt (2008) have argued that the magnitude of the financial flows required to finance U.S. current-account deficits will increase at a faster rate than the willingness of the world's central banks to accumulate dollar reserves, eventuating in a collapse of the

¹ See DFG (2003, 2004a, 2004b, 2005, 2006, 2009).

² In addition to Japan, DFG (2003, p. 5) include China, Hong Kong, Korea, Malaysia, Singapore and Taiwan in the group comprising the new periphery.

³ DFG (2004a, 2005) projected that the BW2 system would last for another 8-10 years (from the mid-2000s).

⁴ See, for example, Eichengreen (2004, 2007), Frankel (2005), Roubini and Setser (2005), Roubini (2006) and Hunt (2008). As Frankel (2005, p.1) put it, "much of their [*i.e.*, DFGs] analysis has been generally accepted."

system. Eichengreen (2007) has pointed-out that, unlike the situation under Bretton-Woods II in which the United States has been running current-account deficits and incurring a rapidly-expanding net foreign debt, the United States registered current-account surpluses through most of the period 1954-71 and was a net investor abroad. Eichengreen (2007) has also noted that during the 1950s and 1960s (1) there was no major alternative currency to challenge the U.S. dollar as the key-international currency and (2) the European countries that formed the periphery constituted a cohesive bloc; under the new regime the dollar faces a strong alternative in the euro⁵ and the countries of the Asian periphery tend to act in a heterogeneous fashion. The factors that differentiate the present system from the earlier regime suggest, in Eichengreen's view, that the present system will not be as long-lasting as the earlier regime.

A second group of authors has challenged some of the key assumptions - - especially with regard to the central role of China - - underlying the Bretton-Woods II story.⁶ In effect, these authors have denied the validity of the Bretton-Woods metaphor. Goldstein and Lardy (2004, 2005) have pointed-out that the DFG hypothesis assumes that inward Foreign Direct Investment (FDI) to China contributes to the build-up of a highly-efficient capital stock that would otherwise be unattainable in that country because of inefficiencies and distortions in the domestic financial system. However, those two authors have pointed-out that foreign investment in China has funded less than five per cent of fixed asset investment in that country in recent years - - far too small a share to offset the alleged misallocation of investment financed through China's domestic banking system. Roubini (2004), Eichengreen (2004, 2007), Rajan and Subramanian (2004), and Goldstein and Lardy (2004, 2005) have argued that DFG underestimated the costs of sterilization in China and other Asian economies, especially those associated with financial repression. Finally, Goldstein and Lardy (2008) and Truman (2008) have noted that exchange-rate policies in many Asian economies, including that of China, have been more flexible than assumed by DFG.

⁵ Frankel (2005) also argued that the existence of the euro helps distinguish Bretton Woods II from Bretton Woods I.

⁶ See, for example, Roubini (2004), Goldstein and Lardy (2004, 2005, 2008), Rajan and Subramanian (2004) and Truman (2008).

Some of the critics of the Bretton-Woods II hypothesis have viewed the financial crisis that broke-out in August 2007 as a confirmation of their prediction that the Bretton-Woods II system would collapse (Hunt, 2008; Sester, 2008). DFG (2009), however, have countered that the causes of the crisis were extraneous to the Bretton-Woods II system. In the view of DFG (2009, p. 1), “the incentives that drive the Bretton-Woods II system will be reinforced by the crisis and, looking forward, participation in the system will expand and the life of the system will be expanded.”

This paper critically assesses the debate about the Bretton-Woods II hypothesis. The remainder of the paper is structured as follows. To put the present system in context, Section 2 briefly outlines key characteristics of the original Bretton-Woods system, circa the mid-1940s until its collapse in 1973. Section 3 describes the central features of the revived Bretton-Woods system, as put forward by DFG. Section 4 provides empirical results that compare the earlier Bretton-Woods regime with the present regime. We report two sets of results. First, we present results of an asymmetry test proposed by Giovannini (1989) to compare the behaviour of the centre country (*i.e.*, the United States) and the periphery under the earlier Bretton-Woods system with the behaviour of the centre country - - again, the United States - - and the periphery under the revived Bretton-Woods regime. Second, we present a new method for decomposition of the logarithm of an observed seasonally adjusted GDP series into the business cycle and other components using a time-varying-coefficient technique that allows us to test the relationship between the business cycle and macroeconomic policies. We apply this technique to five countries for three sub-periods over the years 1959 to 2007: 1959-68, 1969-1997, and 1998-2007. The 1959-68 sub-period corresponds to the so-called “heyday” of the original Bretton-Woods system; the 1969-1997 period corresponds to a period of transition to the revived system; and, the 1998-2007 period corresponds to the Bretton-Woods II system. Our method of separating business cycle from other components of a seasonally adjusted series allows us to compare the changes in business cycle as a result of macroeconomic policies under the two systems during the three sub-periods. Section 5 concludes.

2. Bretton-Woods I, revisited

The system that was agreed at Bretton-Woods, New Hampshire, in July 1944 had several major objectives, including the following.⁷ First, it sought to avoid the exchange-rate instability of the floating-rate regime of the 1920s, which was seen as having impeded external adjustment and the post-World War I reconstruction of trade and finance.⁸ Second, it aimed to prevent a repetition of the beggar-thy-neighbour policies that had characterized the latter stages of the interwar gold-exchange standard, during which countries used trade restrictions and competitive currency devaluations to increase trade surpluses (or reduce trade deficits) in attempts to reduce domestic unemployment, shifting that unemployment to other countries (Solomon, 1977, p. 1; Bordo, 1993, p. 35; Cohen, 2002, p. 2). Third, it endeavoured to provide autonomy for national authorities to pursue domestic policies targeted at achieving full employment. Fourth, it sought to attain symmetric adjustment between those countries with balance-of-payments surpluses and those with balance-of-payments deficits. Fifth, it aimed to achieve symmetric positions among national currencies within the international financial regime.

To help achieve these objectives, a new institution, the International Monetary Fund (IMF), was established and charged with promoting collaboration on international monetary issues, facilitating the maintenance of full employment, maintaining stable exchange rates, providing a multilateral payments system and eliminating exchange restrictions, and providing financial assistance to members with balance-of-payments deficits, thereby easing external disequilibria (Yeager, 1976, pp. 390-91; Solomon, 1977, p. 12; Bordo, 1993, pp. 34-35).⁹ Each member of the Fund was required to establish a par value for its currency in terms of either gold or the U.S. dollar and to maintain the market

⁷ The architecture of the system was decided before the Bretton Woods conference, in negotiations that began in 1942 between UK officials and U.S. officials (Kenen, 1993). The following account is based on Yeager (1976), Solomon (1977), Meltzer (1991), Bordo (1993), Kenen (1993), MacKinnon (1993), Cohen (2002), and Eichengreen (2008).

⁸ The interwar period can be divided into three broad exchange-rate regimes: (1) general floating from 1919 to 1925; (2) the gold exchange standard from 1926 until the early 1930s; and (3) a managed float from the early 1930s until 1939 (Bordo, 1993, p. 6). The view that floating exchange rates discourage international trade and finance and impede external adjustment gained prominence as a result of Nurske's report (1944) for the League of Nations. Nurske's view was based mainly on his interpretation of France's experience with flexible exchange rates during the mid-1920s. Nurske's interpretation of that episode was criticized by Friedman (1953).

⁹ The Fund's Articles of Agreement came into effect at the end of 1945. The Fund's governing body, the Board of Governors, first met in March 1946.

exchange rate of its currency within one per cent of the declared par value, by intervening in the foreign-exchange market by buying and selling the currencies of other countries. Instead of the rigid exchange rates of the gold-exchange standard, and the floating rates that characterized the mid-1920s, the earlier Bretton-Woods regime featured fixed-but-adjustable exchange rates. Parities could be changed with Fund approval if a member faced a “fundamental disequilibrium” on its external accounts.¹⁰ Moreover, each member of the Fund was expected to make its currency convertible for current-account transactions (Solomon, 1977, p. 12; Bordo, 1993, p. 35; Kenen, 1993, p. 235; Bordo and Eichengreen (2008). Fund members were allowed to use controls on capital-account transactions. Controls on the capital account permitted some autonomy for the conduct of domestic monetary policies.¹¹

The system that emerged was considerably different from that which had been intended. Instead of a system of equal currencies, the U.S. dollar was the centre of the system. The U.S. Treasury, which entered the Bretton-Woods period holding three-fourths of the global monetary gold stock (Meltzer, 1991), pegged the price of the dollar at 35 dollars per ounce of gold by freely buying and selling gold to official bodies. Other countries intervened to keep their currencies within one per cent of parity against the dollar by buying and selling dollars (Bordo, 1993, pp. 37 and 49). In 1949 a group of 24 countries devalued their currencies against the dollar; however, exchange-rate adjustments among the major currencies became less-frequent over time for the following reasons:¹²

1. *Reputation* - - the concern that devaluation would result in a decline in national prestige.
2. *Speculation* - - the concern that an acknowledgement that a change in parity was being considered would trigger self-fulfilling capital flows.

¹⁰ The term “fundamental equilibrium” was never defined. The Fund could not disapprove a change in parity, however, if the change was less than ten per cent (Bordo, 1993, p. 35).

¹¹ A post-war transitional period was provided during which Fund members could circumvent the ban on controls over current-account transactions. Countries maintaining controls for more than five years after the start of Fund operations - - that is, beyond 1952 - - were expected to consult with the Fund about them annually. See Yeager (1976, p. 391) and Bordo (1993, p. 35).

¹² The following listing is based, in part, on Obstfeld (1993, p. 230). See, also, Meltzer (1991) and Bordo (1993).

3. *Retaliation* - - expectations that other countries would respond to a devaluation by a particular country with a devaluation of their own and/or with trade barriers.
4. *Terms-of-trade effects* - - the concern that a devaluation would raise the prices of imports and lower the price of exports, resulting in a transfer of resources from home consumption to foreign consumption.
5. *Expenditure reduction* - - recognition that the possible inflationary effects of a devaluation would require a compression of domestic absorption, with possible political costs for the government implementing the devaluation.

For most of the 1950s and the 1960s, major European countries and Japan used capital controls to maintain undervalued real exchange rates against the U.S. dollar in the pursuit of export-led growth (Meltzer, 1991, p. 87). In turn, throughout the 1950s and the 1960s the United States ran balance-of-payments deficits, supplying dollar liquidity to the rest of the world.¹³ In this connection, a key characteristic of the system was that the United States played the role of world banker; specifically, the United States engaged in maturity transformation, providing short-term liquidity services (*i.e.*, borrowing short-term) and supplying fixed direct investment (*i.e.*, lending long-term) to the rest of the world (Despres, Kindleberger and Salant, 1966). Convertibility on current transactions of major European currencies was not put in place until the end of 1958; the Japanese yen did not become convertible on current account until 1964.

The years 1959 to 1967 are sometimes identified as the heyday of the Bretton-Woods I system (Meltzer, 1991; Bordo, 1993; Cohen, 2002). As mentioned, the year 1959 marked the return to convertibility of European currencies. In addition, that year seemed to mark the turning point from a global dollar shortage to a global dollar glut.¹⁴ Prior to 1958, less than ten per cent of cumulative U.S. balance-of-payments deficits since the end of World War II had been financed through U.S. gold sales as European governments were keen on accumulating dollar reserves (Cohen, 2002, p. 6). After 1958,

¹³ However, from 1959 until 1971, the United States ran current-account surpluses. The absolute size of the surpluses began to decline in 1964. See Bordo (1993).

¹⁴ The transformation from a dollar shortage to a dollar glut underlined the so-called Triffin dilemma. See Triffin (1957).

European governments attempted to limit dollar holdings, converting those holdings into gold; from 1959 until 1968 almost two-thirds of the U.S. cumulative balance-of-payments deficits were financed from U.S. gold reserves (Cohen, 2002, p.6). Throughout the 1960s, successive U.S. Administrations sustained and/or strengthened controls on trade and capital transaction to reduce the U.S. balance-of-payments deficits and stem the outflow of gold (Meltzer, 1991, pp. 58-63; Bordo, 1993, pp. 58-59).

The identification of 1967 as the end-year of the heyday of the Bretton-Woods I regime reflects two important events that took place the following year. First, a run on sterling and the dollar into gold brought a collapse of the gold-pool agreement in March 1968. Created in 1961 by eight major countries (Belgium, France, Germany, Italy, the Netherlands, Switzerland, the United Kingdom, and the United States) to stabilize the U.S. dollar price of gold (at \$35 an ounce) on the London market (the main trading centre for gold), the gold pool became a key pillar of the Bretton-Woods I regime.¹⁵ With the abandonment of the gold pool, the price of gold for official transactions remained at \$35 per ounce but the members of the gold pool did not attempt to control the price of gold in *private* transactions; in order to prevent arbitrage, central banks agreed not to sell in the gold market (Meltzer, 1991, p. 63). Second, in March 1968 the Federal Reserve removed the 25-per-cent gold backing requirement against the issuance of Federal Reserve notes. As Bordo (1993, pp. 70-72) argued, “the key effect of these [two] arrangements was that gold was demonetized at the margin... In effect, the world switched to a *de facto* dollar standard.”¹⁶ Additionally, the Federal Reserve’s removal of the gold-backing of the notes completed a transition, encompassing several decades, to a pure fiat domestic money standard.

The Bretton-Woods I system continued to operate until early 1973, but the years 1969 through 1973 were marked by a huge and unsustainable expansion in U.S. dollar-denominated global liquidity (see Section 4, below), several foreign-exchange crises, and *ad hoc* arrangements aimed at sustaining the system.¹⁷ In light of (1) the relatively-short

¹⁵ See Yeager (1976, pp. 425-27) and Eichengreen (2007, Chapter 2).

¹⁶ Similarly, Yeager (1976, p. 575) argued that “with convertibility at an end, the world was on a *de facto* dollar standard rather than a genuine gold-exchange standard.”

¹⁷ The crisis involving major currencies included the attacks against the French franc in 1969 and the U.S. dollar in 1971. The *ad hoc* arrangements included the August 1971 decision by the Nixon Administration to

duration of the Bretton-Woods I regime, (2) the fact that even during its heyday it was sustained by a series of controls on current-account and capital-account transactions by successive U.S. administrations, and (3) its propensity to generate unsustainable increases in U.S. dollar liquidity, it is surprising that recent work by DFG offers such a sympathetic treatment of the earlier regime. The next section considers DFG's thesis.

3. Bretton-Woods revived

Two factors form the main backdrop to the Bretton-Woods II story. First, during the period 2002 to 2007 a large accumulation of global reserves took place.¹⁸ While global reserves rose by about 50 per cent between 1998 and 2002, they rose by 120 per cent between 2002 and 2007. Moreover, reserve accumulation during the latter period was underpinned mainly by Asian emerging market economies. Underlying the reserve accumulation were the following drivers: (1) export-led growth strategies, especially on the part of Asian emerging market economies, supported by undervalued exchange rates and controls on capital flows; (2) an excess of domestic savings over domestic investment in many Asian emerging market economies, combined with underdeveloped domestic financial systems in those economies; and, (3) unilateral self-insurance (in the form of precautionary reserve holdings) in the aftermath of the series of exchange-rate crises, especially the Asian crisis of 1997-98, that struck emerging market economies in the mid- and late-1990s.

Second, the large accumulation of reserves was used mainly to finance growing U.S. current account deficits.¹⁹ All other factors held the same, the deficits should have become increasingly difficult to finance as the net international investment position of the United States declined. With investors becoming increasingly reluctant to invest in U.S.-

suspend the convertibility of the U.S. dollar into gold and other reserve assets and the Smithsonian Agreement of December 1971, which included, among other things, devaluations of the U.S. dollar against gold and major currencies. See Bordo (1993).

¹⁸ Unless otherwise noted, reserves are net of gold, SDR holdings and reserve positions in the Fund. The data in the text are from the IMF's *International Financial Statistics*.

¹⁹ As a percentage of GDP, the U.S. current-account deficit rose steadily from about 3 per cent in 1999 to 6 per cent in 2006; it then fell to 5.3 and 4.6 per cent in 2007 and 2008, respectively. Source, IMF *World Economic Outlook* (2009).

dollar-denominated financial instruments, yields and spreads on those instruments would have been expected to rise. In fact, however, nominal yields and spreads on dollar-denominated instruments fell during the period 1999 through the mid-2000s (DFG, 2006). What accounts for this circumstance? DFG argued that, after the collapse of Bretton-Woods I, the structure of the international monetary system came “full circle to its essential Bretton-Woods era form”, allowing the U.S. current account deficits to be financed while both nominal interest rates and interest-rate spreads on U.S. financial instruments fell (DFG, 2003, p. 2).

The basic DFG story runs as follows. During the late 1980s/early 1990s, with the fall of the planned economies, hundreds of millions of unemployed workers joined the world’s market economies. This situation created an excess supply of labour that should have driven global interest rates upward.²⁰ However, these workers were, in the aggregate, large net savers. An enormous increase in saving occurred in emerging Asian economies. Based on this circumstance - - that is, a huge increase in the supply of labour that came with an enormous rise in saving - - DFG posited that the global economy did not face a problem of excess saving. Instead, the global economy faced a problem of an excess supply of labour.

To absorb the excess labour supply, emerging Asian economies followed export-led growth strategies, similar to the strategies followed by European countries and Japan under the Bretton-Woods I regime. In turn, rapid growth in Asia contributed to high oil prices, leading to high saving rates in oil-producing countries (mainly in the Middle East). In this connection, DFG (2005, p. 3) pointed-out that, between 1999 and 2004, almost all of the increase in saving rates in the Asian and Middle-Eastern regions was matched by a fall in the saving rate of the United States. Moreover, almost all of the increase in the dollar value of saving in emerging Asia and the Middle East was placed in dollar-denominated international reserves, reflecting both growth strategies aimed at maintaining undervalued currencies, the underdeveloped state of domestic financial systems in those regions, and the deep and broad U.S. financial system.

²⁰ All other factors held the same, a rise in the supply of labour increases the marginal productivity of capital, causing real interest rates to rise.

DFG (2003, 2004a, 2004b, 2005) have argued that the emerging Asian economies form a new periphery. They also have argued that, for countries in the periphery, the benefits of stable, undervalued currencies exceed the costs of reserve accumulation. China, for example, relies on export-led-growth to absorb hundreds of millions of workers from its agricultural sector in its industrial-traded-goods sector. Reserve accumulation by Asian and other central banks allowed the United States to rely on domestic demand to underpin its growth and finance its current-account deficits. DFG have also argued that the old periphery - - consisting of Western Europe, Canada and parts of Latin America - - interacts with the centre with flexible exchange rates; its aggregate current account has been roughly in balance. As under the older system, the United States remains the centre country, pursuing a monetary-policy strategy that overlooks the exchange rate.

Two other points about the DFG hypothesis are important to mention. First, DFG (2004c) argued that reserve accumulation by China and other emerging-market economies can be thought of as collateral held against the stock of FDI in those economies. In this total-return-swap, China gets the return on dollar-denominated financial instruments (mainly, U.S. Treasury securities) and foreign investors get the return on equity. Thus, as under Bretton-Woods I the United States engages in maturity transformation. Second, DFG (2009) argued that global financial crisis that erupted in August 2007 was not caused by the global current-account imbalances since the crisis did not entail a sudden stop of capital flows to the United States, which would have led to a large depreciation of the U.S. dollar. To the contrary, the U.S. dollar appreciated against most major currencies during the crisis. In their view, “the crisis was caused by ineffective supervision and regulation of financial markets in the U.S. and other industrial countries” (DFG, 2009, p. 3). Consequently, DFG (2009) argued that the Bretton-Woods analogy continues to define the international monetary system.

In sum, DFG identified a number of similarities between the international monetary system of the 1950s and 1960s and the system that has operated in recent years. (1) As was the case under the Bretton-Woods I regime, the present system is comprised of a centre country and a group of countries constituting a periphery. The centre country has been the United States in both regimes. (2) Under both systems, there is asymmetric

behaviour, with the U.S. ignoring external factors in setting interest rates, and the periphery largely following the fixed-rate rules-of-the game. (3) Under both regimes, the periphery follows an export-led growth strategy based on undervalued currencies, pegged against the U.S. dollar and supported by controls on capital flows. (4) Under both regimes, the undervalued currencies give rise to a massive accumulation of foreign-exchange reserves mainly in the form of low-yielding U.S.-dollar-denominated financial instruments. (5) Under both systems, the United States provides the main export market for the periphery, underpinning the periphery's export-led growth strategy. (6) As was the situation in the earlier regime, in the new regime the United States serves as world banker, providing financial-intermediation services for the rest of the world. (7) As was the case with the Bretton-Woods I system, the present system will prove to be transitory but sustainable and metamorphic. At some point in time, "there will be... another wave of countries, as India is now doing, ready to graduate to the periphery" (DFG, 2004, p. 308).²¹

4. Empirical results

In what follows, the results of two sets of empirical procedures are presented. First, we perform an asymmetry test to compare the behaviour of the centre country and the periphery under the earlier and the revived Bretton-Woods systems. Second, to carry this comparison farther, we propose and apply a new method of decomposition of an observed seasonally adjusted series into the business cycle and other components that allows us to infer the relationship, if any, between the business cycle and macroeconomic policies.

The two empirical tests below have a clear relationship to each other, although they deal with different aspects of the asymmetry hypothesis. The simple asymmetry question is the idea that the core Bretton-Woods country (the United States) behaved differently from the periphery. Specifically, under this simple version of the asymmetry hypothesis, the United States ignored external factors in formulating monetary policy while the

²¹ As noted above, DFG predicted that the present version of the Bretton-Woods system would last some ten years from the mid-2000s.

periphery took external influences into account in formulating monetary policy. We conduct tests of this hypothesis for both the earlier and the new Bretton Woods systems in order to assess whether the countries at the center and periphery of both systems behaved in a similar manner in both regimes. Next, we investigate determinants of the business cycle under both systems. Our aim is to examine if the relationship between macroeconomic policies and the business cycle was similar in both systems. In the two sub-sections below, we first test the asymmetry hypotheses using the test proposed by Giovannini, a test which focuses on monetary policy. We then go on to propose a new procedure for detrending the business cycle, a procedure which allows us to examine the impact of both monetary policy and fiscal policy on the business cycle.

4.1 The Giovannini test

The United States registered official-settlements balance-of-payments deficits every year from 1958 until the end of the Bretton-Woods I system, with the exception of the years 1968 and 1969 (Bordo, 1993, p. 55). These deficits arose because U.S. net capital outflows exceeded the U.S. current-account surpluses.²² The persistent U.S. balance-of-payment deficits were perceived to be a reflection of what was called “the adjustment problem” (Bordo, 1993). Specifically, as the reserve-currency country, the United States financed its balance-of-payments deficits by issuing U.S. dollars liabilities to the rest of the world, negating the need to take domestic policy adjustment (Meltzer, 1991, pp. 63-65; Bordo, 1993, pp. 55-60).²³ An implication of this situation is that the earlier Bretton-Woods regime was an asymmetric system, under which the United States was free to pursue domestic objectives while countries at the periphery gave up their domestic target to achieve stability of foreign-reserve flows (Giovannini, 1989, p. 24).

Giovannini (1989) proposed a test of the asymmetry hypothesis for the earlier Bretton-Woods regime which focuses on the behaviour of monetary policy. In what follows, we apply that test as a gauge for comparing the behaviour of the centre country, the United States, and the countries at the periphery under both the Bretton-Woods I and II regimes. Giovannini (1989) estimated regressions of a proxy for internal balance on a

²² As mentioned above, the United States ran current-account surpluses each year from 1959 to 1971.

²³ The Federal Reserve routinely sterilized dollar outflows so that the outflows did not affect the U.S. money stock (Bordo, 1993, p. 56).

measure of external balance using data from the earlier Bretton-Woods regime. His sample consisted of four countries - France, Germany, the United Kingdom, and the United States. He assumed that the domestic target variable was the domestic money-market interest rate while the external target variable was the change in foreign exchange reserves divided by the level of high-powered money. Giovannini used quarterly data over the period 1962:Q2-1971:Q4 for France, Germany, and the United States; for the United Kingdom, he used quarterly data over the period 1964:Q2-1971:Q4.²⁴ The explanatory variable (*i.e.*, the change in foreign-exchange reserves divided by high-powered money) was entered in the regressions as an eight-quarter distributed lag. The basic idea underlying the test proposed by Giovannini runs as follows. If the United States was concerned about only internal balance, leaving the countries at the periphery to worry about external adjustment, under the asymmetry hypothesis the sum of the coefficients of the lags for external balance in the regression for the United States should not be significantly different from zero. For countries at the periphery, seeking to achieve stability of foreign-reserve flows, the sum of coefficients should be negative and significantly different from zero under the asymmetry hypothesis.

Giovannini's results are reproduced in Panel A of Table 1.²⁵ His basic finding was that both the United States and the United Kingdom took external balance into account in setting interest rates, but France and Germany did not do so. These results are inconsistent with both the asymmetry hypothesis and with the findings contained in other work on policy-setting under the earlier Bretton-Woods system.²⁶

Giovannini's estimation procedure presents at least two important problems. First, his sample period does not correspond to "heyday" period. It begins in 1962, not in 1959 when the major European currencies became convertible, and extends beyond 1968, the year in which the gold-pool agreement collapsed and the United States removed the gold backing requirement on Federal Reserve notes. Second, Giovannini's data for international reserves, taken from the *International Financial Statistics (IFS)*, exclude

²⁴ The author did not provide an explanation for the difference in estimation periods.

²⁵ Giovannini (1989) did not provide information on the sums of coefficients. He reported only sample periods, R^2 's, and the p-values of F-tests.

²⁶ In commenting on Giovannini's results, Eichengreen (1989, p. 45) stated that "these results are perplexing." Bordo and Eichengreen (2009) found that the Federal Reserve did not take external factors into account in conducting monetary policy in the 1960s and early 1970s.

gold. The use of reserves excluding gold may be appropriate for analysis of the post-Bretton-Woods era, but it is not appropriate under Bretton-Woods during which gold movements played a key role in reserve flows among countries.

To deal with the above problems, we re-estimated Giovannini's regressions for his sample of four countries over the period 1959:Q2 to 1968:Q4, using total reserves (*i.e.*, including gold).²⁷ We also included Japan in the sample of countries. Since that country implemented current-account convertibility in 1964, we used that year as the first year of our sample. However, this procedure left us with only 11 degrees of freedom²⁸. Therefore, we extended the sample period to run through 1972:Q4 for Japan.

The results are reported in Panel B of Table 1. As would be expected under an asymmetric regime, for France, Germany, and Japan the sum of coefficients on the external balance variable is negative; moreover, in each case the sum is significant (at least at the 10 per cent level).²⁹ As would also be expected under the asymmetry hypothesis, for the United States, the sum of the coefficients on the external balance variable is not significant, suggesting that the United States did not take external balance into account in setting interest rates. For the United Kingdom, the sum of the coefficients on the external-balance variable is negative but insignificant. This finding is consistent with the role of the pound sterling as the second key international currency during the 1960s.

To help compare the earlier Bretton-Woods system with the Bretton-Woods II regime, we applied the Giovannini specification to the countries that comprise the centre - - the United States - - and the periphery - - China, Hong Kong, Korea, Japan, Malaysia and Singapore under the revived Bretton-Woods system.³⁰ The results for the period 1998:Q1-2007:Q4 are reported in Panel C of Table 1. As under the Bretton-Woods I regime, the results suggest that the United States did not take external balance into

²⁷ Using reserves minus gold, and Giovannini's sample period, we were able to replicate his results. For example, for the United States we obtained an R^2 of .55, compared with the .52 obtained by Giovannini, and a significance level (F-test) of .000, the same as that obtained by Giovannini.

²⁸ That is, twenty quarterly data points minus the constant term and eight lags.

²⁹ Extension of the sample period to 1972:Q4 produced a negative and significant sum of coefficients for France and a negative but insignificant sum of coefficients for Germany.

³⁰ As noted above, DFG also included Taiwan in the periphery. DFG included Japan in both the earlier and new periphery (see DFG 2004a, p. 311). Our data source is the *IFS*, which does not report data (other than reserves) for Taiwan. We use the term "country" loosely to include Hong Kong.

account in setting interest rates. For the six countries at the periphery, only the regression for Korea³¹ had a negative and significant (at the 10 per cent level) sum of coefficients on the external balance variable. For the remaining five countries, the sum was either insignificant (China, Japan, Malaysia and Singapore) or significant but positive (Hong Kong).³²

In sum, the results of the test of the asymmetry hypothesis suggest that the United States did not take external factors into account in setting interest rates under both the earlier and the revived Bretton Woods systems, supporting that hypothesis. However, the results for the countries forming the periphery are not supportive of the asymmetry hypothesis under the revived Bretton Woods system. For the earlier system, the results for the periphery support the hypothesis.

The above results assume that both the probability of rejecting the asymmetry hypothesis when it is true, and the probability of accepting the asymmetry hypothesis when it is false, implied by the asymmetry test are very small. These probabilities are not small if there is a misspecification of the model on which the test is based. In the next sub-section we base our model on very general assumptions so that the specification biases involved in the model can be negligible.

4.2 A new trend-business cycle decomposition

In this section we use a new trend-business cycle decomposition to compare the behaviour of the centre country and the periphery under both the earlier and the revived Bretton-Woods systems. This decomposition allows us to consider the interaction of both fiscal and monetary policies with the business cycle. The basic aim of this decomposition is to break up a deseasonalised time series into three components - - a trend, a business cycle, and an irregular component, as follows:

$$x_t = c_t + T_t + v_t \tag{1}$$

³¹ It should be noted that Korea had a form of inflation targeting for at least part of this period.

³² All other sample periods (*e.g.*, 2002:Q1-2007:Q4) yielded similar results - - *i.e.*, negative and significant sums of coefficients for Korea and insignificant sums of coefficients for the remaining countries. The finding that the sum of coefficients was insignificant may indicate that the countries concerned engaged in sterilisation of reserve flows.

where x_t is the deseasonalised series of interest, c_t is the business cycle, T_t is the trend and v_t is the irregular component. These components cannot be independent of each other unless they are determined by disjoint sets of variables, which is not typically the case. Under the assumption that the components of a series are independent of each other, a variety of methods for decomposing the series has been proposed, but because of this independence a common problem with these methods is that, although they may provide separate estimates of the cycle and the trend, they cannot, on their own, give an indication of what is influencing the cycle, what may be associated with the cycle, or how the trend interacts with the cycle.³³ Additionally, the models used to estimate the components can be misspecified. To address these issues, we set-out a new trend extraction method, based on the time-varying-coefficient (TVC) methodology.³⁴

The method we propose is to decompose a series (in our case the logarithm of deseasonalised real GDP for a country) in the following way;

$$x_t = \beta_{1t} + \beta_{2t}t \quad (2)$$

where β_{1t} and β_{2t} are time-varying coefficients, t is a deterministic time trend, $\beta_{2t}t = T_t$, and $\beta_{1t} = c_t + v_t$. Thus, the right-hand-side of the equation provides a complete explanation of x_t . The trend model (2) with time-varying intercept and slope can be nonlinear. We can parameterize the model by assuming that β_{1t} and β_{2t} are functions of a set of observed variables, which we call coefficient drivers, plus an error term:

$$\beta_{1t} = z_t' \alpha_1 + \varepsilon_{1t} \quad (3)$$

$$\beta_{2t} = z_t' \alpha_2 + \varepsilon_{2t} \quad (4)$$

where z_t' is a $1 \times N$ vector of variables that act as coefficient drivers and which we believe may be indicators of, or associated with, the business cycle, the trend, the irregular component, and changes in the growth rate of x_t ; ε_{1t} and ε_{2t} are the disturbances that

³³ See, for example, Enders (2004, pp. 156-238).

³⁴ The particular methodology is presented in Swamy and Tavlas (2001, 2005, 2007) and Hall, Hondroyiannis, Swamy and Tavlas (2009).

follow stationary autoregressive AR(1) processes.³⁵ The variables in z partly explain the variations in the intercept and slope of the trend in (2).³⁶

Subtracting the trend from the series leaves the business cycle and the irregular component, which are captured by β_{1t} . We have kept the model for T_t very general so that it can be correctly specified. The equation $T_t = \beta_{2t}t$ is called “a mixed deterministic and stochastic trend model” because $z'_t\alpha_2t$ and $\varepsilon_{2t}t$ are its deterministic and stochastic components, respectively. The variables in z affect both β_{1t} and β_{2t} . These variables and the covariance between ε_{1t} and ε_{2t} capture the pair-wise interactions among the components of x_t in (1). These interactions are typically overlooked in the classical decomposition of variables into trend, cyclical, and irregular components.

We assume that the business cycle is given by

$$c_t = \sum_{i \in S_1} \alpha_{i1} z_{it} + u_t \quad (5)$$

and the irregular component is given by

$$v_t = \sum_{i \in S_2} \alpha_{i1} z_{it} + \varepsilon_{1t} - u_t \quad (6)$$

where the α_{i1} and z_{it} are the elements of α_1 and z_t , respectively. Thus, we can further decompose the coefficient β_{1t} by breaking the coefficient driver set into two sub-sets S_1 and S_2 where S_1 consists of all those elements of z_t which we believe are indicator variables or variables that are correlated with the business cycle and S_2 consists of all those elements of z_t which may indicate irregular events (dummy effects for unusual events or other non-cyclical events which may have affected GDP). The terms $\sum_{i \in S_1} \alpha_{i1} z_{it}$

and u_t are the deterministic and stochastic components of the mixed deterministic and stochastic model for c_t in (5), respectively. The above models for c_t , T_t , and v_t imply

³⁵ We avoid the assumption that ε_{1t} and ε_{2t} are random walks because these processes lead to unconditionally inadmissible and inconsistent estimators. See Hondroyannis, Swamy and Tavlás (2009).

³⁶ This circumstance does not, of course, imply that the trend in GDP is deterministic since the coefficient on the trend can vary in each period both systematically with z and randomly.

that all the components of x_t are non-stationary and can be affected by policy variables and/or can undergo structural shifts.

All the coefficients in (3) and (4) are constant so that they can be estimated and standard inference on their significance may be obtained. In addition to the advantages we have already pointed out above, we believe that this trend-cycle decomposition based on equations (2)-(6) offers a number of advantages compared with the standard alternatives: (1) it has a clear structural interpretation; (2) it is flexible, in the sense that we can explicitly incorporate effects for events that are clearly not cyclical in nature without overly restricting the functional forms of the models for the cycle, the trend, and the irregular component; (3) we may test whether policy actions are pro-(or counter-) cyclical increasing (or reducing) the amplitudes and periods of a business cycle or for the significance of the correlation between policy variables and the cycle; and (4) we may consider the presence of structural shifts in the cycle and it should allow a more structural understanding of the nature of the economic cycle. Our focus below will be on the correlation between policy variables and the cycle.

Simultaneous estimation of β_{1t} and β_{2t} leads to that of the components of x_t without overly restricting their functional forms (see equation (2)). In principle, simultaneous estimation of the components is superior to their separate or stepwise estimation that is highly likely to introduce numerically major inconsistencies. This is a key advantage of the model in (2)-(6).

Swamy, Tavlas, Hall and Hondroyiannis (2008) show how the TVC model in (2) might be estimated subject to the constraints imposed by equations (3) and (4) and then its time-varying coefficients decomposed to give estimates of the parameters of the model that are free from specification biases resulting from incorrect functional form, omitted variables and measurement error. The key to this decomposition is to use a set of variables - - the coefficient drivers - - to explain the time variation in the coefficients. Intuitively, coefficient drivers, which should be distinguished from the econometrician's instrumental variables, may be thought of as variables, though not part of the explanatory variables of the model, serve two purposes. First, they deal with the correlation between the included explanatory variables and *their coefficients*. Second, the coefficient drivers

allow us to decompose the coefficients of the TVC model into their respective components.

To illustrate the practical application of our procedure, we applied it to U.S. seasonally adjusted real GDP data over the sample period 1959:Q1-2007:Q4, and compared it with the business cycles derived from the standard Hodrick-Prescott (HP) filter and a deterministic trend model. The resulting cycles are shown in Figure 1. As shown in the figure, the turning points of the cycles are similar, but the amplitude of the cycles seem to vary in a systematic way: the HP filter tends to exhibit the smallest cycles; the deterministic trend model has the largest cycles; and, the TVC model has cycles which tend to lie between the other two. This result reflects well-known problems with the HP filter, which tends to follow the cycle too closely so that the trend is influenced by the cycle (Harvey and Jaeger, 1993). The correlation coefficient between the TVC cycle and the HP cycle is .74 and correlation coefficient between the TVC cycle and the deterministic trend cycle is .83. The correlation coefficient between the HP cycle and the deterministic trend cycle is .56.

4.3 Applications

Next, we applied the above procedure to quarterly seasonally adjusted real GDP data for five countries - - the United States, Japan, Germany, the United Kingdom, and France. The data source was the *International Financial Statistics (IFS)*. The estimation period was 1959:Q1 to 2007:Q4, although in the case of France estimation began with 1970:Q1 because of the unavailability of quarterly real GDP data for that country before that date. For each country, we decomposed the log of seasonally adjusted real GDP into two components - - a time-varying trend and a time-varying measure of the business cycle, as in equation (2) above. In estimating equation (2), we used three coefficient drivers (in addition to the constant term) to correspond to policy variables that might be associated with the business cycle. The coefficient drivers were the following:

- (1) The log of government consumption-to-GDP ratio. This ratio was de-trended using Hodrick-Prescott filter.³⁷

³⁷ While we do not wish to enter the debate over the problems with the Hodrick-Prescott filter, we would note that the TVC estimation technique used here is robust to measurement error. Hence, even if we believe

- (2) A measure of the real interest rate: the nominal interest rate - - either an overnight money market rate, if available (*e.g.*, the Federal Funds rate for the United States), or the 3-month t-bill rate - - minus the annualised rate of inflation as measured by the GDP deflator.
- (3) The log of the nominal exchange rate. For the United States, the exchange rate series was the IMF's effective exchange rate. For the other countries, the exchange rate was the bilateral dollar rate, under the assumption that this was the key exchange rate under the earlier Bretton-Woods system. For all countries, an increase in the exchange rate represents a nominal appreciation. The exchange rate was entered into all equations with a one-period lag.³⁸

All these coefficient drivers are included in S_1 of (5). In order to discern whether there was a change in the determinants of the business cycle between the times of the earlier and revived Bretton-Woods regimes, we broke the sample period into three sub-periods: (1) 1959:Q1-1968:Q4, corresponding to the heyday period of the earlier Bretton-Woods regime; (2) 1969:Q1-1997:Q4, corresponding to what could be viewed as a transition period; and (3) 1998:Q1-2007:Q4, corresponding to the revived Bretton-Woods regime.

Table 2 reports the results for the United States. The following findings merit comment. (1) The only policy variable that was a significant determinant of the business cycle in each sub-period was the de-trended ratio of government consumption-to-GDP, which acted in a counter-cyclical direction (*i.e.*, a cyclical expansion was associated with a decline in the de-trended ratio of government consumption to GDP). (2) The real interest rate was significant (at the 10 per cent level) only in the third sub-period, during which it was positive, so that a cyclical expansion was associated with a rise of real interest rates. The implication of this result is that the policy response of the Federal Reserve to the business cycle was different in the Bretton-Woods II regime compared

that this is not an ideal de-trending method the TVC approach will still compensate for this and yield a consistent estimate of the business cycle.

³⁸ The lag was used so as to avoid any possibility of reverse causation, whereby the business cycle may be causing movements in the exchange rate.

with the Bretton-Woods I regime.³⁹ In the Bretton-Woods II regime the Federal Reserve raised nominal interest rates by more than the expected inflation rate during cyclical expansions. In the earlier Bretton-Woods regime, the real interest-rate variable was insignificant. (3) The exchange rate was an insignificant determinant of the business cycle in all three regimes.

Tables 3 through 6 present results for Germany, the United Kingdom, Japan, and France, respectively. For Germany, the exchange rate was significant in the second and third sub-periods, during which it was pro-cyclical - - the expansionary phase of the cycle was associated with an appreciation of the exchange rate (Table 3). This circumstance may reflect the large appreciation of both the deutsche mark (second sub-period) and the euro (third sub-period) against the dollar during much of those sub-periods. Government consumption was counter-cyclical and significant in the second sub-period, but pro-cyclical and significant in the third sub-period. Real interest rates were positive in all three sub-periods (*i.e.*, real rates rose in the expansionary phase of the cycle), but were significant only in the second and third sub-periods.

For the United Kingdom (Table 4), the exchange rate was insignificant in all three sub-periods. Government consumption was significant only in the first sub-period, during which it was counter-cyclical. Real interest rates were significant only during the second sub-period, during which they were pro-cyclical (*i.e.*, real interest rate rose during the expansionary phase of the cycle).

As mentioned above, Japan (Table 5) was part of the periphery in the earlier Bretton-Woods regime and that country comprises parts of the periphery in DFG's revived Bretton-Woods regime. The results for Japan (Table 5) provide little support for the hypothesis that the business cycle was associated with similar policies under the earlier regime and the revived regime. The ratio of government consumption to GDP was counter-cyclical in both regimes but significant in only the Bretton-Woods II regime.

³⁹ We, of course, acknowledge that we have not attempted to identify every aspect of the differences between the two regimes. Clearly, many things changed, including the leadership of the Federal Reserve as well as many important external influences such as the wars in the Middle East in the latter period. However the TVC approach should help considerably to compensate for these inevitable omissions. Under TVC as the measurement of the business cycle should be robust to these omitted variables, although the coefficients on the drivers could be affected if there was a strong correlation between the omitted driver effects and the included ones

Real interest rates were significant in both regimes but pro-cyclical in the earlier regime and counter-cyclical in the latter regime, perhaps reflecting the negative real interest rates in Japan in the late-1990s and early-2000s. The exchange rate was insignificant in both regimes.

As mentioned, we were able to obtain quarterly real GDP data for France only from the beginning of 1970. Accordingly, we estimated regressions for two sub-periods for France - - 1970:Q1-1997:Q4 and 1998:Q1-2007:Q4 (Table 6). For both sub-periods, the ratio of government consumption to GDP was positive and significant, indicating that government consumption was pro-cyclical. Real interest rates were insignificant in the second sub-period, indicating that the European Central Bank raised real rates during cyclical expansions. The exchange rate was insignificant in both sub-periods.

With regard to the Bretton-Woods II hypothesis, the above findings do not provide support for the view that the nominal effective exchange rate was associated with the business cycle under either the Bretton-Woods I or the Bretton-Woods II regimes. For the United States, real interest rates were pro-cyclical and significant in the latter regime, but were not significant in the former regime. For Japan, a member of the periphery under both the earlier and the recent Bretton-Woods regimes, real interest rates were pro-cyclical and significant in the earlier regime but counter-cyclical and significant in the Bretton-Woods II regime. In both regimes, the ratio of government consumption-to-GDP was counter-cyclical while the exchange rate was not significantly associated with the business cycle.

5. Concluding observations

In light of the above discussion, the following conclusions emerge.

First, although the earlier Bretton-Woods system operated formally from 1947 until 1973, the years considered to mark the heyday period were 1959-68, a relatively-short duration in terms of the longevity of international monetary regimes. Moreover, the heyday period included several currency crisis involving major currencies and a succession of restrictive measures on trade flows and capital movements by the United

States aimed at reducing that country's balance-of-payments deficits (Meltzer, 1991; Bordo, 1993). Given this set of circumstances, it is surprising that DFG offer such an uncritical assessment of the performance and longevity of the earlier regime.

Second, in terms of the provision of a nominal anchor, perhaps the defining characteristic of an international monetary regime, the revived Bretton-Woods system resembles the earlier system during the years 1969-73, during which time the international monetary regime was on a pure fiat money standard. The years 1969-73 were marked by a series of international financial crises and an explosion of global liquidity, leading to the collapse of the earlier Bretton-Woods system. Thus, in contrast to those authors who argue that specific *differences* between the earlier and revived Bretton-Woods regimes may imply a short-duration for the latter regime, we suggest that the *similarity of monetary standards* of the regimes may also imply an unstable tenure for the revived Bretton-Woods regime.

Third, the results of asymmetry tests performed on the key participating countries in the earlier and revived Bretton-Woods regimes suggest that (i) the United States did not take external balance into account in setting interest rates under either regime, (ii) most countries forming the periphery took external factors into account in setting interest rates in the earlier system, and (iii) most countries forming the periphery in the revived regime did not take external factors into account in setting interest rates. Thus, the results for the periphery do not support the view that we have entered a revived Bretton-Woods regime; the periphery conformed to the asymmetry hypothesis in the earlier regime, but not in the revived regime.

Fourth, we proposed a new method for decomposing seasonally adjusted economic time series. The results of applying that method suggest that, for the United States, France and Germany, monetary policy was pro-cyclical during the years comprising the revived Bretton-Woods system, in contrast to the situation under the earlier regime. In general, the exchange rate and the ratio of government spending-to-GDP do not appear to be clear-cut, systematic determinants of the business cycle under either regime. For the United States, the centre in both the earlier and revived Bretton-Woods systems, the detrended ratio of government consumption-to-GDP was counter-cyclical and significant

under both systems and the nominal effective exchange rate was insignificant under both systems. However, the real interest rate was pro-cyclical and significant in the revived Bretton-Woods system but insignificant in the earlier system. For Japan, a member of the periphery in both systems, there is little evidence that the relationship between policy variables and the business cycle was similar under the two systems. Thus, the results of this method are consistent with our findings for the asymmetry hypothesis.

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Appendix

Table 1

Panel A: Giovannini's (1989) Results *

	Country			
	US	UK	Germany	France
	1962:Q2-1971:Q4	1964:Q2-1971:Q4	1962:Q2-1971:Q4	1962:Q2-1971:Q4
R-squared	0.56	0.59	0.19	0.16
F-tests (p-values)	0.00	0.00	0.52	0.40

Panel B: Bretton-Woods I*

	Country				
	US	UK	Germany	France	Japan
	1959:Q2-1968:Q4	1959:Q2-1968:Q4	1959:Q2-1968:Q4	1959:Q2-1968:Q4	1964:Q1-1972:Q4
Sum of coefficients	94.02	-44.00	-9.72	-61.19	-4.38
R-squared	0.14	0.15	0.36	0.72	0.36
F-tests (p-values)	0.79	0.74	0.06	0.00	0.10

Panel C: Bretton-Woods II*

	Country						
	US	Japan	Hong-Kong	Korea	Malaysia	China	Singapore
	1998:Q1-2007:Q4						
Sum of coefficients	-346.89	-2.7	10.27	-2.12	-5.60	-4.22	-0.20
R-squared	0.32	0.25	0.44	0.55	0.25	0.16	0.18
F-tests (p-values)	0.12	0.28	0.03	0.00	0.34	0.64	0.56

*Notes: The estimation method is OLS, the dependent variable is the appropriate domestic money market interest rate. The F-statistic tests the null hypothesis that the coefficients of lagged ratio of reserve flows relative to high powered money are equal to zero. Eight lags are employed in all regressions.

Table 2

USA: Business Cycle Estimation			
Variables	Period: 1959:Q1-1968:Q4	Period: 1969:Q1-1997:Q4	Period: 1998:Q1-2007:Q4
Constant	9.2924*** (3.27)	8.2573*** (22.21)	8.8306*** (47.05)
Detrended government consumption-GDP ratio	-0.5790** (-2.73)	-0.48025*** (-4.73)	-0.2347** (-2.02)
Real interest rate	0.0073 (1.58)	-0.0003 (-0.45)	0.0031* (1.68)
Nominal effective exchange rate	-0.3348 (-0.55)	-0.0080 (-0.10)	-0.0470 (-1.29)

Notes: ***, **, * indicate significance at 1%, 5% and 10% level of significance, respectively. The figures in parentheses below the coefficient estimates are the t-ratios.

Table 3

Germany: Business Cycle Estimation			
Variables	Period: 1960:Q3- 1968:Q4	Period: 1969:Q1- 1997:Q4	Period: 1998:Q1- 2007:Q4
Constant	5.9783*** (6.01)	6.0701*** (112.6)	6.8962*** (466.26)
Detrended government consumption-GDP ratio	-0.2523 (-1.41)	-0.1590*** (-3.04)	0.2215*** (3.98)
Real interest rate	0.0003 (0.38)	0.0007** (2.46)	0.0026** (2.37)
Exchange rate	0.177 (0.24)	0.0670* (1.74)	0.0568** (2.36)

Notes: ***, **, * indicate significance at 1%, 5% and 10% level of significance, respectively. The figures in parentheses below the coefficient estimates are the t-ratios.

Table 4

UK: Business Cycle Estimation			
Variables	Period: 1959:Q1-1968:Q4	Period: 1969:Q1-1997:Q4	Period: 1998:Q1-2007:Q4
Constant	1.2121 (0.32)	0.1555** (2.60)	0.7874*** (43.11)
Detrended government consumption-GDP ratio	-0.7424*** (-5.68)	-0.1050 (-1.03)	0.0330 (0.38)
Real interest rate	-0.00003 (-0.18)	0.0008** (2.02)	-0.0005 (0.85)
Exchange rate	1.3441 (0.36)	0.0011 (0.02)	0.0508 (1.42)

Notes: ***, **, * indicate significance at 1%, 5% and 10% level of significance, respectively. The figures in parentheses below the coefficient estimates are the t-ratios.

Table 5

Japan: Business Cycle Estimation			
Variables	Period: 1959:Q1-1968:Q4	Period: 1969:Q1-1997:Q4	Period: 1998:Q1-2007:Q4
Constant	33.990 (0.76)	13.951*** (31.72)	13.271*** (94.70)
Detrended government consumption-GDP ratio	-0.9149 (-1.10)	0.6543** (2.43)	-0.6379*** (-3.33)
Real interest rate	0.0010** (2.95)	0.0011*** (6.27)	-0.4429*** (-5.20)
Exchange rate	3.9015 (0.51)	0.3100*** (4.13)	0.035 (1.22)

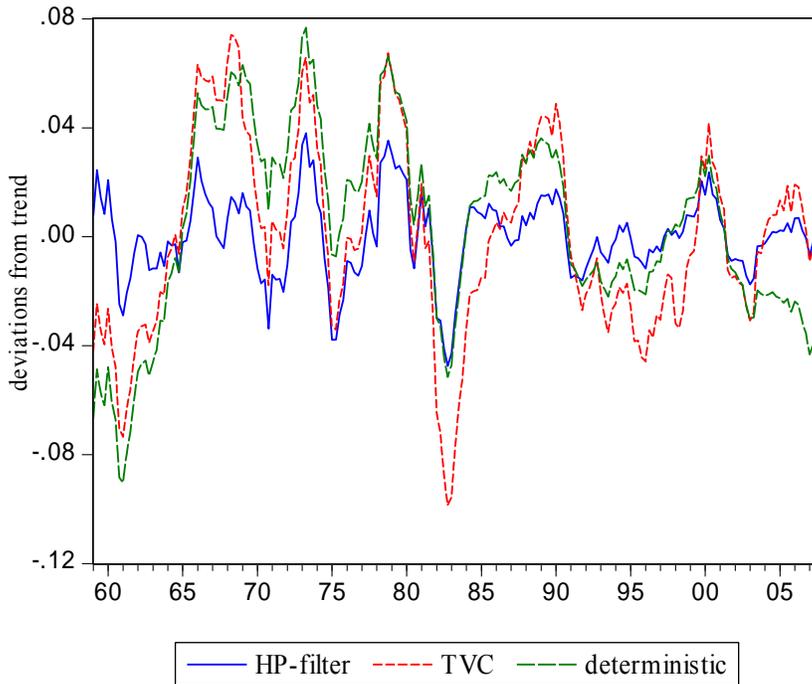
Notes: ***, **, * indicate significance at 1%, 5% and 10% level of significance, respectively. The figures in parentheses below the coefficient estimates are the t-ratios.

Table 6

France: Business Cycle Estimation			
Variables	Period: 1959:Q1-1968:Q4	Period: 1970:Q2-1997:Q4	Period: 1998:Q1-2007:Q4
Constant	<i>N.A.</i>	6.9575** (195.39)	7.6984*** (282.15)
Detrended government consumption-GDP ratio	<i>N.A.</i>	0.1316** (2.09)	0.1162** (2.32)
Real interest rate	<i>N.A.</i>	0.0003 (0.95)	0.0009*** (4.81)
Exchange rate	<i>N.A.</i>	-0.0052 (-0.25)	0.0200 (1.32)

Notes: ***, **, * indicate significance at 1%, 5% and 10% level of significance, respectively. The figures in parentheses below the coefficient estimates are the t-ratios.

Figure 1
Estimated Business Cycles in USA, 1959:Q1-2007:Q4



Note: this figure contrasts estimates of the business cycle derived from a standard HP filtered trend and a determinist trend with our new model based on the TVC methodology.

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