Exchange Rate Regime Transitions and Growth

by

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1 Introduction

Since the collapse of the Bretton Woods system in the early 1970s and the subsequent departure from fixed exchange rate regimes for much of the industrialized world, a great deal of research has focused on defining the link between exchange rate regimes and various macroeconomic variables. This paper examines one such link, that of exchange rate regime transitions and output growth.

Economic growth theory suggests that exchange rate regime choice may have an impact on the growth rates of real per capita GDP — if in nothing more than a country's transition to their steady state. Such theory, however, has yet to come to a definitive conclusion as to which regime best promotes growth. Empirical work on the subject has had similarly ambiguous results.

On the one hand, pegged regimes may reduce relative price volatility and add credibility to monetary policy, subsequently stimulating investment and trade, and thereby increasing growth. (Ghosh *et al.*, 1997) On the other hand, flexible exchange rate regimes may promote growth through their ability to adapt to real economic shocks, thereby preventing unemployment, inflation, and other negative impacts that may occur under the monetary policy of a fixed regime. (Broda, 2001)

With the principal exception of the European Monetary Union, much of the world is evolving towards floating exchange rate regimes. This trend, along with the lack of theoretical consensus over which regime is best, has motivated much of the empirical research on the topic. Empirical work, for the most part, has focused on post-Bretton Woods era data, and has concentrated on finding the most appropriate classification scheme for exchange rate regimes. I add to the existing literature in this essay by (a) examining both pre- and post-Bretton Woods data, using Reinhart and Rogoff's (2002) "natural" Classification scheme of *de facto* exchange rate regimes, and (b) creating an exchange rate regime variable that measures the *change* in regimes as opposed to the regimes themselves.[1] The purpose of this variable, which was motived by the Henry (2007) essay on transitional effects of capital account liberalization, is to examine transitional effects of exchange rate regimes as

[1]Reinhart and Rogoff (2002) developed this natural classification in their paper, however they used the classical *de jure* three-way classification scheme when conducting their empirical work.

opposed to quantifying impacts of the regimes themselves, as most other studies have done.

In the second section of this paper I examine a brief history of exchange rate regime choice, as well as the macroeconomic "trilemma" theory which is the basis for much of the research on exchange rate regimes. The third section reviews existing theoretical and empirical research. The fourth section reviews methods for classification of exchange rate regimes. In the fifth and sixth sections I present and discuss my empirical results, and test the robustness of these results. The final section concludes.

2 A Brief History of Exchange Rate Regime Choice

At the basis of exchange rate regime theory is the hypothesis of the macroeconomic "trilemma" (or impossibility trinity), which states that countries may only have two out of three of the following policy objectives — independent monetary policy, open capital markets, and a fixed exchange rate. Mundell (1963) and Fleming (1962) found that if a country has an open economy, allows for capital mobility, and employs a floating exchange rate regime, then that country is able to insulate itself against real shocks (such as inflation or a terms of trade shock) all the while maintaining independent monetary policy.

Prior to 1946 much of the industrialized world adhered to the gold standard, a system of fixed exchange rates. This system was initially abandoned by many countries during World War I due to shocks to the financial system that accompanied the war. After the war ended, may countries reinstated the standard, however it was abandoned for a second time soon after in the early 1930s. Bordo (2003) suggests that the collapse of the Gold Standard can be attributed to both flaws in the system's design, as well as a loss of credibility that arose from opposing goals for full domestic employment and sustained gold convertibility.

The post-Gold Standard era during the 1930s saw capital controls in place in most advanced countries. After the Second World War many of those countries moved towards an adjustable peg as part of the Bretton Woods system. By the 1960s the Bretton Woods system broke down as a result of many countries using expansionary monetary and fiscal policy to boost their economics (or in the case of the United States, to help finance the Vietnam War). The trilemma constraints is also blamed for the collapse of Bretton Woods. Bordo (2003) notes that by being required to peg their exchange rates and prac-

tice independent monetary policy, along with the increasingly difficult task of preventing capital mobility, countries were finally forced to abandon the system. Since the collapse of Bretton Woods, and until today, most advanced countries have operated under floating or intermediate exchange rate regimes.

3 Evidence on Exchange Rate Regimes and Growth

Despite the large amount of research, both empirical and theoretical, that has been focused on determining the link (if any) between exchange rate regimes and growth, no definitive conclusions have been reached to date. The assumption at the core of much of the research, as Bailliu *et al.* (2002) point out, is the belief that a country's choice of exchange rate regime has consequences for economic growth either directly, through effects on the adjustment to shocks, or indirectly, through its impact on other determinants of growth (such as investment, international trade, capital flows, and financial sector development, among others). Early work on the subject, specifically by Mundell (1968), suggested that the long-run equilibrium growth rate is the same in both fixed and flexible regimes, but it is the adjustment process towards that equilibrium that is different. Determining the adjustment process, and how it differs between regimes, is at the heart of most research. In this section I review both theoretical and empirical findings on the relationship between exchange rate regime choice and growth.

3.1 Theoretical Evidence

Early theoretical arguments by Mundell (1963), Fleming (1962), and Friedman (1953), suggested that when flexible exchange rate arrangements are accompanied by independent monetary policy they tend to foster higher growth than fixed regimes would. This growth can be achieved either directly or indirectly. The direct link between regimes and growth is through their ability to adapt to real economic shocks (both foreign and monetary). (Bailliu *et al.*, 2002) Flexible exchange rate regimes can insulate a country's domestic economy from these shocks, limiting both output and inflation volatility. Lower output volatility is then linked with greater long-run output growth, particularly for OECD countries. (Kneller and Young (2001); Bailliu *et al.* (2002)) This automatic stabilizer mechanism works in the

following way:

> When domestic prices are sticky and change slowly in response to shocks, a negative shock leads to a depreciation of the nominal exchange rate. This in turn, reduces the relative price of tradable goods at precisely the moment when demand for them has fallen and therefore partially offsets the effect of the negative shock. Furthermore, the nominal depreciation increases the domestic price of the export good exactly when its foreign price has fallen, also helping the economy have a smoother adjustment. Broda (2001)

Despite the ability for flexible exchange regimes to be more able to mitigate shocks, Bailliu *et al.* (2002) claim that they may also be more prone to shocks than their fixed counterparts. A shock under a flexible regime, they explain, may exacerbate the business cycle and dampen growth compared with a similar shock in a fixed regime. This may be especially pronounced for countries with weak financial institutions.

Several studies, including Domac *et al.* (2001), have found that fixed, or pegged, exchange rate regimes are preferable to flexible regimes when shocks to the economy are associated with unstable domestic monetary and financial policies. They provide insulation against nominal shocks (such as a shift in money demand), have a higher degree of credibility, less flexibility, and have monetary policy focused almost solely on maintaining their peg. Fixed exchange rate regimes are thought to help foster investment, output, and trade growth by reducing exchange rate volatility which in turn lowers the cost of these activities and increases their volume.[2] Finally, pegged regimes may also reduce uncertainty in monetary policy and interest rates. This in turn may reduce inflation by creating a visible measure of discipline, which can make a country more attractive for investment, thereby generating growth.[3]

These arguments for pegged regimes, however, have been directly contradicted by other theorists. First, when a country with a pegged exchange rate experiences a negative shock, it must live with the effects because of a lack of monetary policy independence. Then, in an attempt to prevent currency depreciation, the country's central bank often causes a rise in unemployment. Such deflationary periods were seen in the UK and Argentina in the 1920s and 1990s respectively. (Broda, 2001) Empirical evidence has also shown that

[2]For more extensive details see Husain *et al.* (2005), Levy-Yeyati and Sturzenegger (2003), and Frankel and Romer (1999)

[3]See Ghosh *et al.* (1997), Aizenman (1994), and Bailliu *et al.* (2002)

it is flexible regimes, not pegged, that tend to favour export growth.[4] Finally, Ghosh *et al.* (1997) and Bailliu *et al.* (2002) point out that pegged exchange regimes may reduce trade and output growth by impeding necessary relative price adjustments, exacerbating protectionist pressures, and reducing the efficiency of a given stock of capital. Pegged rates may also raise inflation by making it easier to shift the cost of "cheating" to future governments.

As these argument show, theorists have not reached a consensus on which exchange rate regime contributes to the highest growth rates. Domac *et al.* (2001) remark that while determining which exchange rate regime is best based on the type of shock a country experiences may appear useful at a first glance, in reality a shock may contain both real and nominal components, so this method alone for choosing a regime is often insufficient. More recent research has shifted toward examining empirical evidence to decide which regime is best for growth.

3.2 Empirical Evidence

Empirical research has also had varied success in determining which exchange rate regime is ideal. The general consensus is, however, that a number of country-specific factor determine which regime is best, in particular the level of economic development and financial sector openness of a country.[5] Developed countries seem to benefit from greater flexibility in their exchange rate, while developing countries show better performance under fixed regimes. Domac *et al.* (2001) suggest this is because developing countries are often plagued by lack of credibility, limited access to international markets, more pronounced adverse effects of exchange rate volatility on trade, high liability dollarization, and high pass-through from exchange rates to inflation. As flexible arrangements are generally associated with increased nominal exchange rate volatility, unless a country's financial sector is developed to the point where it can absorb exchange rate shocks and provide agents with appropriate hedging instruments, this volatility can have damaging effects on the real economy. (Bailliu *et al.*, 2002) Consequently 'benign neglect', or a floating exchange regime, is often not a

[4] See Nilsson and Nilsson (2002), who suggest this is because they are less likely to create conditions for persistent misalignments.

[5] Openness itself, however, may be endogenous to the exchange rate, as Juhn and Mauro (2002) suggests. In this case it would be difficult to determine the causal relationship between the two variables

feasible option for many developing countries.

Despite many attempts to quantify the relationship between exchange rate regimes, several studies have failed to find a robust link, in particular for developed countries. These studies have all focused on post Bretton Woods era data, during which time many developed countries have had some form of intermediate or floating regime (in a *de jure* sense). Results from Husain *et al.* (2005) suggest that the recent notion that pegged exchange rates are problematic everywhere is misplaced. Such regimes, they showed, tend to be beneficial for poorer developing countries with little access to international capital, in allowing them to experience lower inflation and higher regime durability. The authors found no robust link for emerging economies between the regime and economic performance, and for advanced economies their evidence suggests that flexible rates may offer greater durability and growth. Domac *et al.* (2001) found even more ambiguous results, and were unable to make any inferences about a particular regime being superior to another in terms of growth performance.[6] Similarly Ghosh *et al.* (1997) failed to find any robust links between growth and currency regimes. They did however, find that the variability of real output tends to be higher under fixed than floating regimes. Ghosh *et al.* (1997) suggest that this lack of evidence reflects a combination of somewhat higher investment ratios under pegged regimes, and slightly higher productivity and trade growth under flexible exchange rate regimes, for developed countries. There has since been shown to be a negative link between real output volatility and exchange rate flexibility.[7]

Bailliu *et al.* (2002) approached the link between growth and exchange rate regimes from a different angle. They suggested that it is not the exchange rate regime per se, but rather the presence of a strong monetary policy framework that is important for economic growth. Their results showed that exchange rate regimes which were characterized by a monetary policy anchor (either exchange rate anchor, monetary target, or inflation target), regardless of the regime type, tended to exert a positive influence on economic growth, while intermediate and flexible regimes without an anchor were more detrimental to growth. Domac *et al.* (2001) examined the effects of exchange rate regime changes. They found that

[6]Their study, however, has severe limitations in that it looked at only 22 countries over a period of less than 10 years.

[7]See Levy-Yeyati and Sturzenegger (2003), Kneller and Young (2001), and Bailliu *et al.* (2002)

countries tend to experience higher growth if they switch from intermediate to floating regimes, or if they switch from floating to intermediate regimes. Countries that switched from a fixed regime to intermediate, or vice versa, experienced lower growth rates. As the results were relatively ambiguous, the authors were unable to draw any firms conclusions with regards to exchange rate regimes and growth.

Edwards and Levy-Yeyati (2005) looked at the link between regime type and growth from yet another perspective. They analyzed empirically the effect of terms of trade shocks on economic performance under alternative exchange rate regimes. In particular they looked at whether terms of trade shocks, both positive and negative, have asymmetric effects on growth and whether the magnitude of these asymmetries depends on the exchange rate regimes. They found that terms of trade shocks are amplified in countries with rigid exchange rate regimes, and this inability to absorb shocks translates into lower growth rates.[8]

3.3 A Note on Capital Controls

As this essay includes capital controls in the statistical model, something which has not been considered in many of the papers mentioned, it is important to explain the arguments for their inclusion. According to the "hollowing of the middle" hypothesis, greater capital mobility prompts countries to move towards either extreme of the exchange rate regime spectrum. These include either hard pegs (including currency unions or currency boards) and pure floats.[9] Eichengreen *et al.* (1999) suggest that an adjustable peg or a tightly managed float with occasional large adjustments are difficult regimes to sustain under high capital mobility.[10] Therefore in an environment of high capital mobility, they say, the exchange rate regime needs to be either a peg that is defended with great determination, or it needs to be a managed float where the exchange rate moves regularly in response to market forces.

This "two extremes" hypothesis, however, is not universally accepted. Edwards (2001) notes that the Asian Policy Forum argues that the extreme exchange rate regimes are not appropriate for Asian economies, but rather intermediate regimes are better, as they are

[8] See also Broda (2001) and Husain *et al.* (2005)

[9] For a more thorough explanation of this hypothesis see Juhn and Mauro (2002), Obstfeld and Rogoff (1995) , and Eichengreen (1994, 1998)

[10] As quoted by Edwards (2001)

more able to mitigate the negative effects of the extreme regimes. As there is no one regime that is better than all others, whether or not a country should adopted a perfectly fixed or floating system depends on specific structural characteristics, including the degree of *de facto* dollarization of the financial system, the extent of labour market flexibility, the nature of the pass-through coefficient(s), and the country's inflation history. (Edwards, 2001)

Because this bipolar hypothesis depends on the fact that countries are open to capital, I feel it is necessary to include and indicator of capital controls as a control in the regression analysis of this study.

4 Classification of Exchange Rate Regimes

The classification of exchange rate regimes has become extremely important in studying the effects of regime type on economic performance. The results of many empirical studies have hinged on how exchange rate regimes are classified.

Earlier work on exchange rate regimes largely divided regimes into one of two categories: fixed or flexible. As very few countries employ a strictly fixed or flexible exchange rate regime (in particular since the collapse of the Gold Standard and Bretton Woods), this classification has evolved into more specific categories over time. Since the fall of Bretton Woods, the popularity of "Intermediate" regimes has grown significantly, along with research on them. The reasoning behind the use of intermediate regimes, according to Williamson (2000) is that they have the potential to reap the benefits from both fixed and flexible regimes without incurring some of their costs.[11] Others, including Fischer (2001) and Husain *et al.* (2005), have a more 'bipolar' view, that intermediate regimes are unsustainable in the long run, and so there tends to be a hollowing out of the middle, with countries moving to either end of the exchange rate regime spectrum (either hard pegs or pure floats). According to Fischer (2001) when a country allows international capital flows, it is only soft pegs which are unsustainable. Other forms of intermediate regimes, along with hard pegs and free floats, he argues, can be sustained.

In 1950 the International Monetary Fund (IMF) began publishing the *Annual Report on Exchange Rate Arrangements and Exchange Restrictions* in which it asked countries to

[11] as quoted by Husain *et al.* (2005)

report their exchange rate regime, according to four regime classifications: fixed, limited flexibility, managed floating, and freely floating. This method, however, was shown to be futile as many countries failed to describe their actual practices (the *de facto* regime) but rather the official policy that they had in place the *de jure* regime). This approach also ignored the fact that in many alleged floats, policy makers tended to intervene in the foreign exchange market to reduce exchange rate volatility. Levy-Yeyati and Sturzenegger (2003) also note that the Report also did not account for periodic devaluations many governments carried out in an attempt to accommodate independent monetary monetary, while claiming to have a fixed exchange rate regime. According to Reinhart and Rogoff (2002) failing to look at market-determined exchange rates may give a false picture of the underlying monetary policy and the ability of the economy to adjust to imbalances. They also note that in many instances dual or parallel markets exist in a country, which implies that the rate at which transactions take place is often quite different than the officially announced rate.

These reporting problems have been shown to make tremendous differences in the outcomes of empirical research and so much of the literature on exchange rate regimes has moved towards making a distinction between *de jure* and *de facto* regimes.[12] By the late 1990s the IMF itself moved towards reporting *de facto* regimes. In this new arrangement, the IMF employs a hybrid specification that combines information on the exchange rate, monetary policy framework, and policy intentions with data on actual exchange rates and reserves movements. (Husain *et al.*, 2005) As of 2000, the IMF has grouped exchange rate regimes in the following way:

1. "Hard pegs": including currency unions, currency boards, and countries with no separate legal tender;

2. "Floats": including managed floats and independent floats; and

3. "Intermediates": including all other regimes, notably conventional pegs, crawling pegs, crawling bands, and basket pegs.

[12]See Levy-Yeyati and Sturzenegger (2003) regression results for different classification scheme for an example

Many studies have tried to either extend or further break-down this three-way official classification scheme (as Ghosh *et al.* (1997) did), while others such as Levy-Yeyati and Sturzenegger (2003) have relied on purely statistical techniques to catalog country practices and determine the *de facto* flexibility of exchange rate regimes.

Reinhart and Rogoff (2002) put forth yet another classification scheme. By using historical specifications, as well as data on market-determined exchange rates, the authors developed a "natural" classification system with 15 categories of exchange rate regimes.[13] One important aspect of this classification system is that it sorts episodes of macroeconomic instability that are characterized by very high inflation rates into a "freely falling" category. Their reasoning for creating this separate category was that when a freely falling episode has a *de jure* classification of floating, intermediate, or pegged, it could incorrectly attribute the macroeconomic disturbances to the exchange rate regime. (Husain *et al.*, 2005)

Based on their natural classification, Reinhart and Rogoff (2002) make several observations about exchange rate regime history — in particular that this history changes drastically when one looks at it through the natural classification system as opposed to the traditional *de jure* classification. They note first that *de facto* regimes differ quite drastically from official exchange rate policy, and that the global distribution of exchange rate regimes has evolved relatively slowly. More specifically, dual and/or parallel markets have been far more commonplace than what is generally thought. In 1950, 45 percent of countries in the authors' sample had dual markets, by 1990 they numbered 20 percent (which the authors still consider a significant amount).

Secondly, the history of exchange rate regime policy appears very different when one looks at *de facto* regimes. *De facto* floating regimes were quite common during the Bretton Woods era of "pegged" exchange rate regimes. In contrast, many officially floating regimes since 1980 are *de facto* pegs, crawling pegs, or narrow bands (about 53 percent of all regimes). Thirdly, after pegs, the most popular exchange rate arrangement has been a crawling peg or a narrow crawling band, accounting for about 26 percent of the observations. Finally, the authors find that under their classification system, episodes of extreme macroeconomic distress (which they quantify as an inflation rate over 40 percent per year)

[13] See Reinhart and Rogoff (2002) for a detailed description of the algorithm used to classify regimes.

were not uncommon. About 12.5 percent of countries in their sample fit into the 'freely falling' category at some time, which is about three times as many observations as in the 'freely floating' category.

This essay uses the Reinhart and Rogoff (2002) natural classification scheme as the basis for exchange rate regime classification. Two different classifications will be used. The first is a three-way classification, which groups the natural classification of Reinhart and Rogoff (2002) into the broad classical categories of fixed, intermediate or floating. I call this the classical classification. It should be noted that despite the use of the IMF's classical terms for exchange rate regimes, the regimes here are not defined in the same way that they were by the IMF (which was in a *de jure* sense), but rather on a *de facto* basis, taken from Reinhart and Rogoff (2002). The second classification scheme uses the five-way break down of the natural classification scheme Reinhart and Rogoff (2002) created in their paper. I call this more detailed version the natural classification. In this scheme the least flexible regime is given a value of one and the most flexible a value of five. Table one shows how regimes are classified. The following section will explain in more detail how these regimes classifications are used to code variables.

5 Data and Initial Observations

The data set encompasses a total of 1595 observations, from twenty-nine OECD countries over the fifty-five year period, 1950-2004. It is an unbalanced panel data set. Because of this several observations have been dropped in the growth regressions, which is why there are significantly less observations in the reported results than the total observations that were listed in the initial Distribution table (Table 4). As there is still a large number of observations (773 in the initial regressions), this is not a concern. Before reviewing the data it is necessary to explain how the the exchange rate regime variable is coded.

As previously mentioned, I am using both a classical (three-way) and natural (five-way) classification scheme for exchange rate regimes. The exchange rate regime variable is coded according to *changes* in the exchange rate regime. For both specifications, there are three separate exchange rate regime variables defined. The first gives a value between -2 and 2 (for the classical specification) or between -4 and 4 (for natural classification), based on the

Table 1: **Exchange Rate Regime Classification**

Actual Exchange Rate Regime	Classical Classification	Natural Classification
No separate legal tender	Fix	1
Pre announced peg, currency board, or currency union arrangement	Fix	1
Pre-announced horizontal band that is narrower than or equal to +/-2%	Fix	1
De facto peg	Fix	1
Pre announced crawling peg	Intermediate	2
Pre announced crawling band that is narrower than or equal to +/-2%	Intermediate	2
De facto crawling peg	Intermediate	2
De facto crawling band that is narrower than or equal to +/-2%	Intermediate	2
Pre announced crawling band that is wider than or equal to +/-2%	Intermediate	2
De facto crawling band that is narrower than or equal to +/-5%	Intermediate	3
Moving band that is narrower than or equal to +/-2% (ie. allows for both appreciation and depreciation over time)	Intermediate	3
Managed Floating	Intermediate	3
Freely Floating	Float	4
Freely Falling	Float	5

Source: Reinhart and Rogoff (2002)

regime change that occurred in any given year. The second exchange rate regime variable takes this value, and lags it by one year. The third variable is assigned the given change value for the year in which the regime change took place, and for the subsequent three years. If a second regime change occurs during those three years, then the variable takes on the value of the new change in the year in which it occurred, and that number is then assigned to the following three years. The exchange rate regime variable is assigned a positive number if the country's exchange rate regime becomes more flexible, and a negative number if it becomes less flexible. If the exchange rate regime switches by one 'step' (*ie.* for the classical scheme from fixed to intermediate, intermediate to fixed or vice versa. Or from 1 to 2, 2 to 3, etc. for the for the natural classification), then it is given a value of 1 (or -1 if the regime became less flexible). If the exchange rate regime undergoes a two step change (for example from fixed to floating in the classical specification), then it is assigned a value of 2 (or -2). For any year in which a country's exchange rate regime does not change, the

variable is assigned a value of zero,[14]

Data was collected from the Penn World Tables, the IMF's *International Financial Statistics*, and the IMF's *Exchange Arrangements and Exchange Restrictions*. Exchange rate regime data was taken from the Reinhart and Rogoff (2002) data set based on their natural classification scheme. Data is limited for early years in Poland, the Czech Republic, the Slovak Republic, and Germany.

The dependent variables are growth (GDPGR), which is measured as real per capita GDP growth, and growth volatility (GDPV), which is measured as the standard deviation of GDPGR of a centered rolling five year period. Control variables used for the regression estimation were taken from traditional growth theory, and specifically from the essay on exchange rate regimes and growth by Levy-Yeyati and Sturzenegger (2003).[15] They include population (as a measure of size) (POP), population growth (POPGR), initial GDP (GDP1950), openness (exports plus imports divided by GDP, which measures the total trade as a percentage of GDP)(OPEN), the investment share of real GDP per capita (INV), capital controls (taken from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*, a dummy variable for whether or not the country had open capital markets)(CAPCON), the change in terms of trade ($\triangle$TT), and finally government consumption lagged one period(GOV(-1)). The government consumption variable is intended to capture public expenditures that do not directly affect productivity but could distort private sector decisions, and is lagged to prevent possible endogeneity problems.[16] In subsequent regressions variables for banking crises, inflation, GDP relative to the U.S. (as a measure of size), and EU member countries are included. The reasons for these final variables will be discussed in more detail in the following section.

The variables of interest in this study are real per capita GDP growth and real per capita GDP growth volatility. The output volatility measure is the standard deviation of GDP growth over a centered rolling five year period. Tables 2 and 3 report summary statistics for these variables. On average, OECD countries had a growth rate of real GDP per capita

[14]Except for in the lagged classification, when the number is assigned in the year after the change, or in the gradual classification scheme where numbers are assigned for the subsequent 3 years after a change.

[15]See Barro and Sala-i-Martin (2004)

[16]For more reasoning behind this variable, see Bailliu *et al.* (2002)

of 2.68 percent over the period examined. This number is more informative when separated by exchange rate regime. Based purely on means, fixed exchange rate regimes have allowed for much higher growth rates than both intermediate and floating regimes. This result is in line with theoretical arguments in favour of fixed exchange rate regimes, which suggest that in creating a more stable and predictable exchange rate and monetary policy, fixed exchange rate regimes promote investment and trade, thereby fostering growth. This result will be examined further through regression analysis in the following section.

Table 2: **Mean Annual Real Per Capita GDP Growth**

		Classical Classification			Natural Classification				
	Overall	Fixed	Intermediate	Flexible	1	2	3	4	5
Mean	2.68	3.19	2.52	1.98	3.20	2.78	2.54	2.19	1.20
	(13.53)	(2.89)	(4.88)	(2.84)	(2.89)	(3.53)	(3.63)	(2.02)	(4.16)
Min	-7.51	-7.51	-11.98	-8.83	-7.51	-11.70	-11.98	-2.52	-8.83
Max	20.68	12.68	20.68	9.84	12.68	15.18	20.68	9.84	7.70

Note: Standard deviation are reported in brackets.
All numbers are in percentage terms.

The volatility of GDP growth is another interesting variable. Based on the five-way classification, freely falling regimes have the most volatile GDP growth by far, something which is not surprising. Freely falling episodes excluded, it is intermediate regimes that have the highest mean and highest single episode of volatility (in both the classical and natural classification), which may reinforce the bipolar hypothesis that was discussed earlier. Based on the natural, five-way classification scheme, it is floating regimes that have the lowest average and lowest absolute value of growth volatility. This result is in line with other empirical findings that claim developed countries perform best under floating regimes.

Table 3: **Mean Annual Real Per Capita GDP Growth Volatility**

		Classical Classification			Natural Classification				
	Overall	Fixed	Intermediate	Flexible	1	2	3	4	5
Mean	2.44	2.31	2.49	2.43	2.31	2.45	2.64	1.71	4.21
	(1.53)	(1.26)	(1.65)	(1.62)	(1.26)	(1.54)	(1.84)	(0.94)	(1.84)
Min	0.32	0.37	0.32	0.36	0.37	0.37	0.32	0.36	1.19
Max	11.84	6.96	11.84	9.02	6.96	8.54	11.84	7.37	9.02

Note: Standard deviation are reported in brackets.
GDP Growth volatility is measured as the standard deviation of a centered rolling 5-year period.

Table 4 presents the distribution of exchange rate regimes, and exchange rate regime changes. OECD countries favoured fixed and intermediate exchange rate regimes over the period 1950-2004, while pure floating regimes were relatively rare. In terms of changes in exchange rate regimes, there were very few instances of large switches (fixed to purely floating, or floating to fixed). The 'fear of floating' theory suggests that countries with fixed exchange rate regimes are unlikely to switch directly to a floating regime, but rather implement some type of intermediate regime that contains elements of both fixed and floating exchange rate regimes.[17] The reverse argument is similar for countries switching from floating to fixed exchange rate regimes. This is a potential explanation for the small number of large regime shifts. There was about an equal number of one-step regime changes over the period (fixed to intermediate, intermediate to floating, or vice versa). Overall, there were 92 instances of exchange rate regime changes by 29 OECD countries over the period 1950-2004.

Table 4: **Distribution of Exchange Rate Regimes**

	Classical Classification			Natural Classification	
	Frequency	Percent		Frequency	Percent
Regime Type			Regime Type		
Fix	645	43.85	1	645	43.85
Intermediate	642	43.64	2	369	25.08
Float	184	12.51	3	273	18.55
			4	135	9.17
			5	49	3.33
Total	1471	100	Total	1471	100
Regime Change			Regime Change		
-2	1	0.07	-3	6	0.40
-1	44	2.99	-2	17	1.15
1	43	2.92	-1	32	2.17
2	4	0.27	1	34	2.31
0	1379	93.75	2	16	1.08
			3	9	0.61
			0	1355	92.11
Total	1471	100	Total	1471	100

6 Growth Regressions

6.1 The Statistical Model

In order to more fully explore the extent to which exchange rate regimes influence output growth in OECD countries beyond that of simple mean observation, I conduct

[17] See Calvo and Reinhart (2002) for a detailed explanation of the 'fear of floating' theory

regression analysis for all country-year observations for which data is available. My model is based on standard growth theory and more specifically on the growth regression analysis of Levy-Yeyati and Sturzenegger (2003).[18] Unlike Levy-Yeyati and Sturzenegger (2003), however, this model does not use separate variables for different exchange rate regimes, which measured growth *levels* for each regime type. Instead I have created a single variable which measures the change in exchange rate regimes. This, along with the creation of both the lagged and gradual effects versions of the regime change variable, will produce results which estimate *transitional* effects from a change in a country's exchange rate regime.

In his review article Henry (2007) claims the reason for the lack of evidence in empirical studies on capital account openness and growth is that all previous studies measured permanent, not transitional, effects through the use of cross sectional data as well as binary dummy variables for openness. While many of the studies on exchange rate regimes and growth I have reviewed here use panel data, they also use binary dummy variables for each exchange rate regime type. Therefore, despite the use of panel data, these independent variables are measuring the permanent effects of specific exchange rate regime types. The definition of the independent variable *Regime Change* that I have used ensures that it is the temporary effects of exchange rate regime changes that are being identified and measured. In particular, the gradual *Regime Change* specification measures the average annual abnormal growth during the year in which the exchange rate regime changed, and the subsequent three years. This choice of a four-year window is based on Henry (2007), who suggested that when studying the neoclassicial growth model for transitional effects, a short window of five years or less is theoretically appropriate.[19] The other specifications I use (both current and lagged) also measure transitional effects, but for one year only.

The purpose of testing for transitional effects is that, for example, it may take several years for investment levels to rise once a country's exchange rate regime becomes more flexible. This could be for various reasons, including the fact that investors may wait some time to ensure that the new regime will be sustainable. Neoclassical growth theory does not predict that countries will differ in their long-run growth rates due to policy differences, but rather that the transition to their steady-state growth rates will differ. Only advances

[18] See Barro and Sala-i-Martin (2004).

[19] See Henry (2007) for a thorough discussion and explanation of the theory.

in total factor productivity (technological advances and population growth) will effect long-term growth rates.[20]

The following is the general linear unobserved effects model for T time periods and i countries:

$$y_{it} = x_{it}\beta + c_i + u_{it}, \qquad t = 1, ..., T \tag{1}$$

The specific regression model for GDP growth is:

$$\begin{aligned} \text{GDPGR}_{it} &= \beta_1 \text{RegimeChange}_{it} + \beta_2 \text{POP}_{it} + \beta_3 \text{POPGR}_{it} + \beta_4 \text{GDP1950}_{it} \\ &\quad + \beta_5 \text{OPEN}_{it} + \beta_6 \text{INV}_{it} + \beta_7 \text{CAPCON}_{it} + \beta_8 \triangle \text{TT}_{it} \\ &\quad + \beta_t \text{GOV}(-1)_{it} + c_i + u_{it}. \end{aligned}$$

After conducting appropriate tests it was determined that the fixed effects estimation approach is most appropriate for the given data set. These tests include the Breusch-Pagan LM test for random effects, which did not reject the null that their variance was zero, thereby suggesting that random effects should not be used. The second test was the Hausman test for fixed versus random effects, which tested the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. In this case the Hausman test reported that fixed effects should be used. . This model assumes strict exogeneity of the explanatory variables on c_i (with E(c_i | $\mathbf{x}_{it}$) permitted to be any function of $\mathbf{x}_{it}$). This assumption will give a consistent estimate of partial effects when time-constant omitted variables are present and can be related to the observable $\mathbf{x}_{it}$.

There are two predominant ways to estimate β under the exogeneity assumption. Either a 'fixed effects transformation' or a dummy variable regression can be used. The fixed effects transformation uses a time-demeaning transformation, where the mean of each cross-sectional variable is subtracted from each country-year observation. This removes the individual specific effects of c_i. This is often called "within effects". Within effects therefore control for the average differences across countries in any observable or unobservable

[20]For a more thorough explanation of why transitions, and not permanent effects on GDP growth rates should be measured, see Barro and Sala-i-Martin (2004) and Henry (2007).

predictors. This leaves only within-group variations, which reduces the potential for omitted variable bias. The major drawback of this method is that it drops any time invariant observations.

The second way to estimate fixed effects is to use a dummy variable regression. This model estimates coefficients for each covariate, plus an intercept dummy variable for each cross-section or time-series obersvation. In this case c_i are parameters to be estimated. N dummy variables, one for each cross section observation (countries, in this case) are created, then OLS is used for estimation. The $\widehat{\beta}_{FE}$ is the fixed effects estimator. The coefficients on all independent variables are identical to those of a within effects estimator and the residuals are the same as those from the within effects estimation as well. Under the assumptions of strict exogeneity and a standard rank condition on the matrix of time-demeaned explanatory variables, then $\hat{c}_i$ is an unbiased estimator of c_i. If we add the assumption that the conditional variances are constant and the conditional covariances are zero then the Gauss-Markov assumptions hold, and $\hat{c}_i$ becomes the best linear unbiased estimation conditional on $\mathbf{x}_{\mathrm{it}}$. (Wooldridge, 2002) This is the method used for the reported regression results in table five and six.

6.2 Classical Classification Results

Table 5 reports regression results for the classical regime classification, with column one reporting the basic (current) specification, column two the lagged specification, and column three the gradual specification. This classical classification gives a positive (although it is statistically insignificant) value for the current regime specification, while the coefficients for the other two specifications have been assigned negative values (which are statistically significant). Focusing on the values which showed significance, the lagged classification has a coefficient of -0.765 (and significant at the 10 percent confidence level). This value is also economically significant, and suggests that as a country's exchange rate regime transitions to a less flexible regime by one step (*ie.* fixed to intermediate, or intermediate to flexible) that country's real per capita GDP growth rate will fall by 0.76 percent (per annum). This is a relatively large drop in GDP growth. When measured with the gradual specification a coefficient of -0.5 was assigned (and significant the 5 percent level). While slightly smaller

than the coefficient on the lagged specification, this number is still economically significant, suggesting that the transition to a more flexible exchange rate regime reduces the real per capita GDP growth rate by 0.5 percent (per annum). This negative coefficient differs from recent empirical evidence, as well as certain theoretical arguments. Much of the empirical research conducted on the impacts of exchange rate regimes, including Levy-Yeyati and Sturzenegger (2003), has found that in developed countries, flexible exchange rate regimes are either associated with slightly higher output growth, or have no link to GDP growth whatsoever. Similarly, theoretical arguments such as the proposition by Friedman (1953) that floating exchange rate regimes are advantageous contradict the results found here.

Table 5: **Growth Regressions** (Classical Classification)

	Basic Specification	Lagged Specification	Gradual Specification
Regime Change	0.126	-0.765*	-0.500**
	(0.345)	(0.401)	(0.216)
POP	-5.09***	-5.24***	-5.14***
	(1.50)	(1.51)	(1.50)
POPGR	-0.487	-0.448	-0.408
	(0.364)	(0361)	(0.362)
GDP1950	-0.001***	-0.001***	-0.001***
	(0.0002)	(0.0002)	(.0002)
OPEN	0.022**	0.022**	0.020**
	(0.008)	(0.008)	(0.008)
INV	0.362***	0.365***	0.371***
	(0.042)	(0.042)	(0.043)
CAPCON	0.042	0.100	0.165
	(0.280)	(0.268)	(0. 271)
$\triangle$TT	-5.92***	-5.79***	-5.70***
	(2.07)	(1.99)	(2.05)
GOV(-1)	-0.033***	-0.033***	-0.031***
	(0.011)	(0.011)	(0.011)
Observations	773	773	773
R^2	0.2890	0.2941	0.2956

Note: Robust Standard errors are reported in parentheses
Australia is dropped from country dummy variables in regressions
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

There are several potential explanations for my result. The first is the exchange rate regime variable I have used. Unlink the empirical studies quoted in my literature review, which all looked at exchange rate regimes using two or more dummy variables for the different regimes types, my regime variable measures exchange rate regime *changes*. Therefore, when my results show that moving *towards* a more flexible regime is detrimental to growth,

it is not necessarily comparable to those results which show that flexible regimes *themselves* are associated with positive growth, and so the coefficients on these different variables should not necessarily have the same sign. The second potential reason for my negative coefficient is that in the three way classification scheme, freely falling episodes are classified in the same category as floating regimes. Often when a country experiences a freely falling exchange rate regime there are serious problems with their financial systems, thus making the group of floating regimes appear less successful than pure floats may be. The natural classification scheme in the next subsection avoids this pitfall by separating freely falling and pure floating regimes. A third theory is that the negative sign arises from the countries in the data set which are not developed. Specifically, the Czech Republic and Slovakia (formerly Czechoslovakia), Poland, and Turkey are often considered 'Emerging Economies'. (Husain *et al.*, 2005) Many empirical studies, such as Husain *et al.* (2005), find that for nonindustrial countries, pegged exchange rates are more beneficial to growth. A final explanation of the negative coefficient on the regime variable is that many of the switches to less flexible regimes occurred when European countries entered the EMU, with Britain shadowing the Deutsche Mark, and other similar occurrences in recent years, while those countries were experiencing high growth rates. Similarily, many OECD countries were members of Bretton Woods and used a pegged exchange rate regime over the period considered the "golden age of growth" in the 1950s to early 1970s. The end of this extraordinary growth era coincided with a shift to more flexible regimes by many countries.

In terms of control variables, population, initial GDP, change in the terms of trade , and government consumption (lagged), are all highly significant and affect GDP growth negatively. While all these variables are significant at the 1% level, it should be noted that population and terms of trade have little real effect on GDP growth (*ie.* not economically significant). For example the change of terms of trade is measured in 100 trillionth's, so a one unit increase in the terms of trade (exports as a capacity to import), will result in a fall of real per capita GDP growth by 5.92e-14 percent. As such, despite the fact that these variables are statistically significant, in economic terms they are relatively insignificant. The negative sign on initial GDP is as expected. As the data set is comprised of strictly OECD countries, and as Barro and Sala-i-Martin (2004) have shown, the absolute convergence

hypothesis holds for the 18 relatively advanced original OECD countries (in 1961). For this group, the initially poorer countries did experience significantly higher per capita growth rates. Population growth, openness, and investment share of GDP are all positive, and statistically significant. Capital controls, which were an additional variable to the Levy-Yeyati and Sturzenegger (2003) regression, showed no significance.

Full regression results with country dummy variable coefficient are reported in Appendix A. There are several interesting points to make with regards to the country dummy coefficients. These values represent that unobserved variables that vary across countries but not across time. The United Kingdom and the United States are the only countries with positive, statistically significant coefficients. Interestingly, all other country variables which are significant (and negative), are European countries, including Austria, Belgium, Denmark, Finland, Greece, Iceland, Ireland, Netherlands, Norway, Spain, Sweden, Switzerland, Italy, and Portugal.

6.3 Natural Classification Results

Table 6 reports growth regressions for the five-way, natural classification scheme. The control variables from this regression are all very similar in terms of both values and statistical significance to the classical classification results. The variable of interest, regime change, takes on the same signs as it previously did, yet the value of the coefficients are much smaller than they previously were, and it now lacks any statistical significance. This suggests that perhaps a country's choice of exchange rate regime has little effect on real per capita GDP growth. These results, therefore are similar to that of Levy-Yeyati and Sturzenegger (2003) and Husain *et al.* (2005), who found little association between exchange rate regimes and output growth for developed countries. As previously mentioned, this natural classification classifies freely falling and pure floating regimes differently than the classical classification, with free falls considered the most flexible exchange rate regime type (given a value of 5, on the 1-5 scale of flexibility). While this more specific classification makes the results more reliable than the three way classification, since I am looking at transitions (and not the regimes themselves) having free falls classified as the most flexible regime may partially account for the negative coefficient on the regime change variable, as it did in the classical

classification.[21]

Table 6: **Growth Regressions** (Natural Classification)

	Basic Specification	Lagged Specification	Gradual Specification
Regime Change	0. 079	-0.313	-0.148
	(0.211)	(0.257)	(0.143)
POP	-5.09***	-5.17***	-5.15***
	(1.49)	(1.50)	(1.49)
POPGR	-0.488	-0.454	-0.443
	(0.364)	(0.362)	(0.361)
GDP1950	-0.001***	-0.001***	-0.001***
	(0.0002)	(0.0002)	(0.0002)
OPEN	0.022**	0.022***	0.022**
	(0.008)	(0.008)	(0.008)
INV	0.362***	0.362***	0.365***
	(0.042)	(0.042)	(0.043)
CAPCON	0.43	0.087	0.097
	(0.279)	(0.270)	(0.273)
△ TT	-5.93***	-5.77***	-5.73***
	(2.08)	(1.98)	(2.04)
GOV(-1)	-0.033***	-0.032***	-0.031***
	(0.011)	(0.012)	(0.011)
Observations	773	773	773
R^2	0.2890	0.2913	0.2903

Note: Robust Standard errors are reported in parentheses
Australia is dropped from country dummy variables in regressions
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

6.4 Growth Volatility

Table 7 reports regression results for real per capita GDP growth volatility for both the classical and natural gradual regime variables. Variables used in this regression are the same as those used in Levy-Yeyati and Sturzenegger (2003), which they took from a variety of growth literature. These variables include volatilities of the investment to GDP ratio (INVV), change in government consumption (GOVV), and the terms of trade[22] (△TTV). I also include certain controls that were used in previous regressions, specifically openness (OPEN) and initial GDP (GDP 1950). As before country dummy variables are included to control for fixed effects. The purpose of this regression is to assess the theory that high

[21]Husain *et al.* (2005) ran a similar regression, but with separate dummy variables for each type of regime under this classification. The dummy variable for freely falling regimes was the only one with a negative coefficient for a group of advanced countries.

[22]All variables measuring volatility are calculated in the same way that the GDP growth volatility measure was - the standard deviation of the non-volatility variables measured around a centered rolling five-year period.

output volatility is associated with slower growth. Therefore, a positive sign on the regime change coefficient would suggest that more flexible regimes are associated with higher output volatility, and thus slower growth.

The coefficients on all three volatility variables are positive, suggesting that higher volatility in macroeconomic fundamentals results in higher output volatility. These variables are all significant at either the 1 or 5 percent level. The coefficient on the regime variable is positive and significant at the 5 percent level for the classical specification and at the 1 percent level for the natural classification, suggesting that as regimes become more flexible output volatility rises. A similar regression by Levy-Yeyati and Sturzenegger (2003) showed that fixed regimes were associated with the highest level of output volatility, which contradicts my results. However, upon further examination they found that for industrial countries the coefficient on fixed regimes was actually negative, so it was non-industrial countries driving their results. This could explain the difference in my results, as my data set of OECD countries is comprised of mainly industrial countries.

Table 7: **Growth Volatility**

	Classical Classification	Natural Classification
Regime Change	0.180**	0.155***
	(0.073)	(0.050)
INVV	0.620***	0.613***
	(0.049)	(0.049)
GOVV	0.023***	0.027***
	(0.007)	(0.007)
$\triangle$TTV	3.68*	2.42*
	(1.95)	(1.85)
OPEN	-0.002	-0.002
	(0.002)	(0.002)
GDP1950	-0.0003***	-0.0003***
	(0.00002)	(0.00002)
Observations	927	927
R^2	0.5149	0.5186

Note: Robust Standard errors are reported in parentheses
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

7 Robustness

Results from these growth and volatility regressions differ slightly from previous empirical results, namely those of Levy-Yeyati and Sturzenegger (2003),Husain *et al.* (2005), and Ghosh *et al.* (1997). A major difference is that in studying regime changes, my results suggest that movements towards less flexible regimes influence growth in a positive way, while these other studies found that less flexible regimes are associated with lower levels of growth. There is less variation between my growth volatility results and those of others, who found that less flexible regimes are associated with higher output volatility, but only for non-industrial countries. Because of these variations it is important to examine the robustness of the results.

7.1 Additional Macroeconomic Variables

In my first robustness check I include additional macroeconomic variables in the regression analysis. This tests for possible omitted variables. These results are presented in Table 8. The additional variables are GDP relative to the US (SIZE), a proxy for size; dummy variables for banking crises (BANK), and inflation, which is lagged one period to reduce potential endogeneity(INF(-1)). Both the banking crisis and inflation variables are included to control for weak macroeconomic fundamentals. Finally a dummy variable for members of the European Union (in 2004) (EURO) is included to control for increased access to trade for these countries. Results are presented for gradual specifications only, as they showed the highest level of significance in baseline results, for both the classical and natural classifications.

Of the additional variables in these regressions, the dummy variables for banking crises and lagged inflation are the only ones that are statistically significant. Both coefficients have negative signs, which is as expected. The coefficient of the regime variable is still negative, and very close to its previous values. For the classical specification the exchange rate regime continues to influence growth (*ie.* it is statistically significant), while under the five-way natural classification it shows little significance.

Table 8: **Including Additional Macroeconomic Variables**

	Classical-Gradual Classification	Natural-Gradual Classification
Regime Change	-0.493**	-0.153
	(0.0217)	(0.145)
POP	-4.00***	-3.99***
	(1.46)	(1.45)
POPGR	-0.351	-0.385
	(0.371)	(0.370)
GDP1950	-0.001***	-0.0008***
	(0.0002)	(0.0003)
OPEN	0.024***	0.025***
	(0.008)	(0.009)
INV	0.339***	0.332***
	(0.047)	(0.047)
CAPCON	0.264	0.201
	(0.277)	(0.280)
$\triangle$TT	-4.19**	-4.91**
	(2.21)	(2.20)
GOV(-1)	-0.005	-0.005
	(0.018)	(0.017)
SIZE	-0.024	-0.024
	(0.024)	(0.024)
EURO	-2.923	-1.938
	(0.586)	(1.438)
BANK	-0.927***	-0.940***
	(0.239)	(0.332)
INF(-1)	-0.035**	-0.036*
	(0.020)	(0.020)
Observations	772	772
R^2	0.3091	0.3041

Notes: Robust standard errors are in parentheses.
Both columns include country dummy variables
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

7.2 Post Bretton Woods

The second robustness check runs the gradual regressions for post-1973 data. Prior to this date the Bretton-Woods system was functioning. After the collapse of Bretton-Woods many OECD countries abandoned their pegs, and shifted towards more intermediate or floating exchange rate regimes (in a *de jure* sense), in general. Table 9 presents the results for the baseline (ie. without the additional macroeconomic variables) regression results for the gradual specification of both the classical and natural classification schemes.

Table 9: **Post-1973 Data**

	Classical-Gradual Classification	Natural-Gradual Classification
Regime Change	-0.703***	-0.257
	(0.273)	(0.173)
Population	-5.31**	-5.24***
	(2.08)	(2.02)
Population Growth	-0.789*	-0.870**
	(0.405)	(0.405))
GDP1950	-0.0007***	-0.0007***
	(0.0002)	(0.0002)
Openness	0.046***	0.049***
	(0.008)	(0.008)
Investment	0.360***	0.347***
	(0.054)	(0.054)
Capital Controls	0.054	-0.045
	(0.274)	(0.273)
$\triangle$ Terms of Trade	-4.75**	-4.66**
	(2.23)	(2.22)
Gov't Consumption (-1)	-0.019	-0.018
	(0.012)	(0.012)
Observations	593	593
R^2	0.3311	0.3227

Notes Robust standard errors are in parentheses.
Both columns include country dummies
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

In terms of control variables, these results are similar in size, sign, and significance to the full time series results. The one that differs slightly is government consumption (lagged one period), which before was significant, and now is not. The coefficient on the regime variable continues to be highly significant in the classical classification, and for both the classical and natural classification it is a smaller number than it previously was. This perhaps suggests that as the OECD countries moved away from the Bretton-Woods era of pegged exchange rate regimes (in general), their exchange rate regime has played less of a role in influencing the country's real output. This further confirms the results of the baseline regression for the natural classification that exchange rate regimes do not play a significant role in influencing GDP growth for developed countries, in particular if we view this natural classification as being best.[23]

[23]This finding is in line with the results of Levy-Yeyati and Sturzenegger (2003), Husain *et al.* (2005), and Ghosh *et al.* (1997)

7.3 Original OECD Countries

A third robustness check I conduct is for the original OECD countries, of which there are 20. OECD countries are also often regarded as developed countries. By including only the original OECD countries in the analysis I am controlling for the possibility that the non-original countries were not developed in the early years of the data set (except for perhaps Turkey, who is an original OECD member), thus influencing the results. Table 10 presents the regression results. Interestingly the coefficient on the regime variable has changed sign, and is now positive. This result may be interpreted as suggesting that when the original OECD countries transition to more flexible exchange rate regimes, their GDP growth is positively influenced. However, the coefficients are highly insignificant (with p-values of 0.775 and 0.446 for the classical and natural specifications respectively). Thus, I do not believe that these results contradict my previous findings, but rather further confirm results of the natural classification baseline regression that exchange rate regime changes have little effect on real per capita GDP growth. The other variable that has changed in these regression is initial GDP, which is now positive. This is to be expected as there is no evidence of convergence within this smaller group of developed countries.

7.4 Free Falling Episodes Excluded

The fourth, and final explicit robustness check I conduct is to control for episodes of free falling exchange rates. As previously discussed, the negative coefficient on the regime change variables throughout the results could potentially be caused by the classification of freely falling episodes as either floating regimes (in the classical classification), or more flexible than floating regimes (in the natural classification). Table 11 presents regression results which have excluded freely falling regimes. The regime change variable is now an interaction term, where the previous regime change variable was multiplied with a dummy variable for freely falling episodes. Therefore any transition to a freely falling episode is now ignored in the regime change variable. Results from estimation with this new variable are more or less similar to our initial results. The regime change variable continues to have a negative coefficient. In the classical gradual specification it is significant at the 5 percent level, in the natural gradual classification scheme it has no statistical significance. Control

Table 10: **Original OECD Members**

	Classical-Gradual Classification	Natural-Gradual Classification
Regime Change	0.067	0.131
	(0.234)	(0.172)
POP	-5.14**	-4.97**
	(2.01)	(2.01)
POPGR	-0.936**	-0.959**
	(0.431)	(0.431)
GDP1950	0.002***	0.002***
	(0.0007)	(0.0007)
OPEN	0.014	0.014
	(0.010)	(0.010)
INV	0.382***	0.378***
	(0.048)	(0.048)
CAPCON	0.036	0.006
	(0.303)	(0.304)
$\triangle$TT	2.00	1.93
	(1.55)	(1.55)
GOV(-1)	-0.028	-0.029
	(0.018)	(0.018)
Observations	579	579
R^2	0.2309	0.2318

Notes Robust standard errors are in parentheses.
Both columns include country dummies
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

variables are all of the same sign and significance as in the baseline model. These results suggest that it not the presence of freely falling episodes that are causing the negative coefficient on the exchange rate regime variable.

Table 11: **Falling Episodes Excluded**

	Classical-Gradual Classification	Natural-Gradual Classification
Regime Change	-0.474**	-0.037
	(0.206)	(0.157)
POP	-5.02***	-5.11***
	(1.50)	(1.49)
POPGR	-0.411	-0.471
	(0.362)	(0.360)
GDP1950	0.0008***	0.0009***
	(0.0002)	(0.0002)
OPEN	0.021**	0.022**
	(0.008)	(0.008)
INV	0.369***	0.363***
	(0.042)	(0.042)
CAPCON	0.156	0.062
	(0.279)	(0.277)
$\triangle$TT	5.83***	5.87***
	(2.05)	(2.05)
GOV(-1)	-0.031***	-0.032***
	(0.011)	(0.011)
Observations	773	773
R^2	0.2942	0.2889

Notes: Robust standard errors are in parentheses.
Both columns include country dummy variables
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

7.5 Endogeneity

While the robustness checks so far have confirmed my initial findings, a final potential problem needs to be examined. As with any study of growth the potential for endogeneity, or reverse causation, exists. This suggests that it would be growth performance which causes exchange rate regime choice, as opposed to the direction of causation that has been addressed so far in this essay (that exchange rate regimes themselves affect growth performance). Levy-Yeyati and Sturzenegger (2003) point out that this problem should be relatively insignificant as economic growth literature has not associated the choice of regime to growth performance. Additionally, the regressions I ran with lagged and gradual regime variables helped to control and prevent effects of reverse causation from showing up in the results. However, it is still important to discuss potential issues arising from endogeneity.

Despite some studies that explicitly test for endogeneity, it would be very difficult to do

here. The sample in this paper includes only OECD countries, and so there exist few instrumental variables which are clearly exogenous and have not been associated with growth over the period, related to exchange rates, and thus could be used to test for reverse causation. Levy-Yeyati and Sturzenegger (2003) use variables such as geographical land area, a dummy variable for islands, the average exchange rate of neighbouring countries, the ratio of GDP to US GDP, and the level of reserves relative to the monetary base. Many of these instruments, however, are not appropriate for our sample. Levy-Yeyati and Sturzenegger (2003) used a much larger sample of countries, which included developed, emerging, and developing economies, making their instruments more applicable. They included measures of size, claiming that geographically smaller countries tend to be more open and favour fixed exchange rates — which is not the case for many of the European countries included in my sample. Levy-Yeyati and Sturzenegger (2003) suggest that the island variable relates to the extraordinary trade propensity of island economies or to their frequent role as international financial centers. In my data this may be true for Japan and Britain, however it would not be so for countries such as New Zealand or Iceland. The one instrument that could have potential for my data set is the regional exchange rate, which indicates explicit or implicit exchange rate coordination with countries that share strong trade links; this is clearly the case for members of the European Monetary Union.

A third justification for not explicitly testing for endogeneity in this paper is that my robustness tests have already controlled for endogeneity to some extent. While the regime classification that I used was based on the classification regime developed by Reinhart and Rogoff (2002), using mainly *de facto* specifications, many of the regime transitions recorded were from either the collapse of Bretton Woods, or the more recent switch for many European countries joining the currency union. The collapse of Bretton Woods has been controlled for through the post-1973 regressions, whose results were in line with the original regressions and produced a negative coefficient on the regime variable. The case of countries adopting the Euro is slightly more ambiguous, and is the major potential for endogeneity in this paper. On the surface one could claim that most countries joined the currency union for political reasons. There are several conditions countries must meet, however, to join. These include specific debt ratios, and a budget deficit of less than three

percent GDP, among others. GDP growth, therefore can affect these requirements, which in turn may have decided whether or not a country can switch from its existing exchange rate regime to become part of the union.

There have been several empirical studies which addressed the issues of exchange rate regime choice. Based on this economic literature there are several reasons why a country adopts the exchange rate regime it has, none of which are GDP growth. Juhn and Mauro (2002) provide the following list of potential determinants of exchange rate regimes;

Optimum currency area variables:	**Capital openness Variables:**
Trade Openness	Capital Controls
Share of trade with largest	*De facto* openness to
Trading partner	Capital flows
Size of economy	Emerging markets
Per capita GNP	
Standard deviation of terms of trade	**Historical and Institutional Variables:**
Fuel exporters	Post-1945 independence
Macroeconomic Variables:	Years since independence
Inflation	Political instability
Reserves	Transition countries

While many of these variables may themselves influence a country's GDP growth rate, that would be an indirect effect between growth and exchange rate regime choice, which is not what a causality test would be looking for in the case of this essay.

Juhn and Mauro (2002) examine a number of empirical studies on the choice of exchange rate regime, and report that the results are rather ambiguous. Of the studies they examined, three studies found GDP growth to be significantly linked to floating regimes, while two found it associated with fixed regimes, and another three found no link whatsoever. Edwards (1996) suggests the choice of regime is based on the structural degree of political instability — the more unstable a country, the more unlikely it is to select a pegged exchange rate. His argument is that stronger governments are in a better position to withstand the political costs of a possible currency crisis associated with pegged regimes, and thus are more willing to adopt such a regime. Edwards (1996), unlike Juhn and Mauro (2002), found that historical GDP growth rates do have a significant effect on regime choice. Namely, countries with poorer performance will have a greater incentive to renege on their low inflation promises, and thus benefit from adopting a more rigid exchange-rate system. Calvo and Mishkin

(2002) recommended that a country's choice of exchange rate regime should be, and often is, of second order importance to the development of good fiscal and monetary institutions in producing macroeconomic success. The authors reviewed a number of different factors a country considered when choosing its exchange rate regime, namely the ability to have domestic monetary policy, reducing inflation, expanding gains from trade, reducing the risk premium in interest rates, widespread loans in a foreign currency, international reserves, lender of last resort, and effects of switching regimes.

These studies, as well as a number of others do not consider GDP growth as a major factor in determining the choice of exchange rate regime, and have not found that it makes a significant difference when it is considered.[24] Thus I believe since the possibility of reverse causality is so small the steps taken to control for it in this essay are sufficient and an explicit test will likely not significantly change any of the results found here.

8 Conclusions

The question of which exchange rate regime best promotes positive macroeconomic performance has been actively debated since the collapse of the Bretton Woods system and the subsequent foray into various types of intermediate and floating regimes for many countries. Despite the large amount of research aimed at answering the question of which regime is best, there has been no general consensus that one regime is better than another. This essay attempted to contribute to the discussion of regime performance by measuring the direction of transitions between regimes, and their impact on growth for OECD countries over a relatively long period of time.

As in many other studies, the results found were slightly ambiguous. Overall I found that transitions towards more flexible exchange rate regimes seem to be either detrimental to growth or have no effect whatsoever, depending on the classification scheme used. This held up to several robustness checks. These results, however, differs slightly from other empirical evidence. Many other studies have found flexible exchange rate regimes to be either associated with higher levels of growth for developed countries, or have no real effect. While these differences appear daunting at first, I was not necessarily expecting my results

[24] See also Poirson (2001), Hausmann *et al.* (1999), and Berger *et al.* (2001), among others.

to be in line with these other studies. In this essay I examined the effects of exchange rate regime *changes* rather than the performance of regimes themselves, as most other studies quoted in this essay did, which may explain in the variation in results.

While I did not explicitly test for the existence of link between low growth volatility and a higher growth rate, taking for granted the literature on this link is valid, I found a positive link between transitions to more flexible exchange rate regimes and output volatility. This indirectly confirms the baseline result which found that when OECD countries moved towards more flexible exchange rate regimes their growth rates were negatively effected.

In a general sense this essay confirms theoretical arguments supporting pegged exchange rate regimes. Based on theory, pegged regimes should help foster investment, output, and trade growth by lowering the costs of these activities and increasing their volume, thereby generating growth. Pegged regimes are also thought to increase credibility in an economy by reducing uncertainty in monetary policy and inflation. (Domac *et al.* (2001); Frankel and Romer (1999); Husain *et al.* (2005)) While I did not explicitly test for these attributes of fixed (or floating) regimes, the finding does confirm that when a country moves towards a less flexible exchange rate regime arrangement its growth is positively affected.

Like many other studies examining the relationship between exchange rate regimes and growth, my study leaves several questions open for research. Looking at specific transitions between regimes, as opposed to general direction as my study did, could reveal further insight into the puzzle of regime performance. Similarly, examining different time periods and sample countries could further clarify the results found here.

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9 Appendix A - Full Regression Results

Table 12: **Growth Regressions**

	Classical			Natural		
	Basic	Lagged	Gradual	Basic	Lagged	Gradual
Regime Change	0.126	-0.765*	-0.500**	0.0795	-0.313	-0.148
	(0.345)	(0.401)	(0.216)	(0.211)	(0.267)	(0.143)
POP	-5.09***	-5.24***	-5.14***	-5.09***	-5.17***	-5.15***
	(1.50)	(1.51)	(1.50)	(1.49)	(1.50)	(1.49)
POPGR	-0.487	-0.448	-0.408	-0.488	-0.454	-0.443
	(0.364)	(0361)	(0.362)	(0.364)	(0.362)	(0.361)
GDP1950	-0.001***	-0.001***	-0.001***	-0.0009***	-0.0008***	-0.0008***
	(0.0002)	(0.0002)	(.0002)	(0.0002)	(0.0002)	(0.0002)
OPEN	0.022**	0.022**	0.020**	0.022**	0.022***	0.022**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
INV	0.362***	0.365***	0.371***	0.362***	0.362***	0.365***
	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.043)
CAPCON	0.042	0.100	0.165 0.043	0.087	0.097	
	(0.280)	(0.268)	(0. 271)	(0.279)	(0.270)	(0.273)
△TT	-5.92***	-5.79***	-5.70***	-5.39***	-5.77***	-5.73***
	(2.07)	(1.99)	(2.05)	(2.08)	(1.98)	(2.04)
GOV(-1)	-0.033***	-0.033***	-0.031***	-0.043***	-0.032***	-0.031***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)
Austria	-5.134***	-5.084***	-4.912***	-5.151***	-5.050***	-4.990***
	(1.216)	(1.229)	(1.210)	(1.219)	(1.22)	(1.207)
Belgium	-4.523***	-4.441***	4.202***	-4.533***	-4.453***	-4.378***
	(1.112)	(1.114)	(1.096)	(1.113)	(1.113)	(1.099)
Canada	0.169	0 .207	0.230	0.173	0.183	0.197
	(0.501)	(0.507)	(0.509)	(0.501)	(0.503)	(0.502)
Czech Rep.	dropped	dropped	dropped	dropped	dropped	dropped
	-	-	-	-	-	-
Denmark	-1.595**	-1.587**	-1.543**	-1.598**	-1.595**	-1.570**
	(0.664)	(0.670)	(0.660)	(0.664)	(0.668)	(0.660)
Finland	-6.667***	-6.694***	-6.655***	-6.682***	-6.624***	-6.614***
	(1.385)	(1.391)	(1.375)	(1.386)	(1.387)	(1.376)
France	-0.989	-0.952	-0.905	-1.004	-0.921	-0.8999
	(0.847)	(0.840)	(0.842)	(0.853)	(0.846)	(0.849)
Germany	dropped	dropped	dropped	dropped	dropped	dropped
	-	-	-	-	-	-
Greece	-6.211***	-6.224***	-6.088***	-6.236***	-6.132**	-6.084***
	(1.528)	(1.549)	(1.527)	(1.532)	(1.542)	(1.521)
Iceland	-3.928***	-3.976***	-3.916***	-3.936***	-3.929***	-3.900***
	(1.136)	(1.147)	(1.136)	(1.135)	(1.143)	(1.131)
Ireland	-3.762***	-3.740***	-3.547***	-3.776***	-3.705***	3.638***
	(1.324)	(1.338)	(1.313)	(1.326)	(1.336)	(1.316)
Japan	-1.043	-0.844	-0.727	-1.062	-0.837	-0.804
	(1.958)	(1.825)	(1.955)	(1.965)	(1.965)	(1.977)
Korea	-0.588	-0.608 -0.539	-0.610	-0.530	-0.500	
	(1.813)	(1.825)	(1.796)	(1.805)	(1.823)	(1.808)

Table continued on next page

	Classical			Natural		
	Basic	Lagged	Gradual	Basic	Lagged	Gradual
Luxembourg	-2.050	-2.034	-1.892	-2.032	-2.119	-2.075
	(1.774)	(1.761)	(1.747)	(1.776)	(1.773)	(1.768)
Mexico	0.026	0.138	0.145	0.008	0.170	0.178
	(1.354)	(1.351)	(1.350)	(1.362)	(1.364)	(1.362)
Netherlands	-2.962***	-2.941***	-2.853***	-2.032***	-2.944***	-2.909***
	(0.675)	(.672)	(0.661)	(0.675)	(0.673)	(0.666)
New Zealand	-0.184	-0.195 -0.192	-0.183	-0.195	-0.163	
	(0.601)	(.604)	(0.597)	(0.600)	(0.604)	(0.599)
Norway	-4.329***	-4.339***	-4.276***	-4.338***	-4.306***	-4.270***
	(0.932)	(0.939)	(-0.932)	(0.933)	(0.937)	(0.929)
Poland	dropped	dropped	dropped	dropped	dropped	dropped
	-	-	-	-	-	-
Slovak Rep.	dropped	dropped	dropped	dropped	dropped	dropped
	-	-	-	-	-	-
Spain	-3.861***	-3.799***	-3.668***	-3.886***	-3.741***	-3.691***
	(1.380)	(1.387)	(1.372)	(1.387)	(1.389)	(1.379)
Sweden	-1.696***	-1.688***	1.635***	-1.702***	-1.681***	-1.644***
	(0.626)	(0.627)	(0.628)	(0.627)	(0.628)	(0.624)
Switzerland	-3.55***	-3.569***	-3.959***	-3.546***	-3.578***	-3.576***
	(0.728)	(0 .728)	(0.726)	(0.729)	(0.729)	(0.730)
Turkey	dropped	dropped	dropped	dropped	dropped	dropped
	-	-	-	-	-	-
United Kingdom	2.746***	2.869***	2.952***	2.745***	2.837***	2.884***
	(0.732)	(0.762)	(0.729)	(0.733)	(0.733)	(0.7411)
United States	14.964***	15.332***	14.974***	14.982***	15.159***	15.084***
	(3.691)	(3.753)	(3.714)	(3.687)	(3.763)	(3.689)
Italy	-2.466**	-2.367**	-2.264*	-2.488**	-2.338**	-2.335**
	(1.188)	(1.186)	(1.182)	(1.195)	(1.189)	(1.186)
Portugal	-4.292**	-4.234**	-4.005**	-4.318**	-4.173**	-4.096**
	(1.680)	(1.697)	(1.69)	(1.683)	(1.693)	(1.666)
Observations	773	773	773	773	773	773
R^2	0.2890	0.2941	0.2956	0.2890	0.2913	0.2903

Note Australia is dropped from country dummy variables.
**Significant at the 10-percent level
***Significant at the 5-percent level
****Significant at the 1-percent level

10 Appendix B

Table 13: **Variables and Sources**

Variable	Definition and Source
GDP Growth	Rate of growth of real per capita GDP (Source: Penn World Tables)
POP	Total population, measured in 100 millionths (Source: Penn World Tables)
POPGR	Population growth, annual percent (Source: Penn World Tables)
GDP1950	Initial per capita GDP (Source: Penn World Tables)
OPEN	Openness, exports plus imports divided by real GDP per capita, in constant prices. Measures the total trade as a percentage of GDP (Source: Penn World Tables)
INV	Investment share of real per capita GDP (Source: Penn World Tables)
CAPCON	Capital Controls, dummy variable=1 if capital controls in place (Source: IMF AREAER LINE 11(later E2))
$\triangle$TT	Change in terms of trade - exports as a capacity to import (constant LCU), measured in 100 trillionths (Source: World Development Indicators)
GOV(-1)	Growth rate of government consumption (Source: International Financial Statistics, IMF)
SIZE	Real GDP per capita relative to U.S. GDP (Source: Penn World Tables)
EURO	Member of European Union in 2002 (Source: http://europa.eu/)
BANK	Dummy variable for banking crises (Source: Reinhart and Rogoff (2002))
INF(-1)	Inflation, lagged one period. % change in CPI (Source: International Financial Statistics, IMF)