Erling Røed Larsen

Are Rich Countries Immune to the Resource Curse? Evidence from Norway's Management of Its Oil Riches

Abstract:
Growth studies show, counter to intuition, that the discovery of a natural resource may be a curse rather than a blessing since resource-rich countries grow slower than others. But it has been suggested that Norway may be an important exception to the curse and that the curse does not afflict rich countries. This article addresses both issues, and introduces a new diagnostic test. Neighbor countries Denmark and Sweden are used to highlight Norway's relative development and to test for curse presence. I employ a structural break technique to demonstrate that Norway started an acceleration in the early 70s, after having discovered oil in 1969, and did not experience a pronounced retardation for the next 25 years. Instead, after first catching-up with its neighbors, Norway maintained a higher pace of growth. Norway might have escaped the curse. However, data suggest a slow-down at the end of the period, opening the possibility of a late onset of the curse. If so, rich countries are not immune.

Address: Erling Røed Larsen, Statistics Norway, Research Department.
E-mail: erling.roed.larsen@ssb.no

| **Discussion Papers** | comprise research papers intended for international journals or books. As a preprint a Discussion Paper can be longer and more elaborate than a standard journal article by including intermediate calculation and background material etc. |

1. Introduction

Most people believe that finding a treasure is a fortunate event that promises future happiness. However, Sachs and Warner (2001) show, puzzlingly, that countries with great natural resources tend to grow slower than countries that have fewer natural resources at their disposal. Gylfason (2001) informs us that Nigeria, despite its oil riches, has the same gross national product as forty years ago. Oil nations such as Iran and Venezuela grew at -1 percent per year from 1965 to 1998. Iraq and Kuwait grew at -3 percent. These disappointing results may arise from negative effects of riches on policies and human endeavor. The riches may be a curse rather than a blessing. There is a growing body of literature on this paradox, recently surveyed by Stevens (2003). As he explains, the resource curse may be intimately linked to another virulent strain, the Dutch Disease, in which the manufacturing sector shrinks as resource extraction displaces it. Such displacement becomes an acute problem for reasons not entirely understood. However, it seems that a country's manufacturing sector appears to be linked to productivity growth and technical advance. Since many resource booms are only temporary or volatile, and since many developing countries have especially fragile manufacturing sectors, the displacement may portend later on-set of stagnant or reversed growth. In addition, authors add that resource revenues tend to invite rent-seeking, an activity to which developing countries are much vulnerable because of weak institutions; see e.g. Baland and Francois (2000) and Paldam (1997). Consequently, it has been suggested that the resource curse only afflicts poor countries. For example, Gylfason points to Norway as an example of a rich country that escaped it. This article asks whether rich countries are immune to the curse, and explores the question by testing whether Norway, an industrialized country at the time of oil discovery in 1969 and a much-cited success story, actually did escape the curse.

I ask this question and test it econometrically because of the important ramifications from the suggestion that rich countries are immune to the curse. Such immunity must be demonstrated empirically, of course, in addition to being explained theoretically. And there are good reasons to believe that such immunity could exist. For example, Auty (2001) lists four necessary conditions for sustainable economic development, and these conditions seem to be shared by developed countries. He argues that mismanagement of resources lies at the core of the curse. Thus, resources, if well managed, will not lead to the curse. Instead, they will create faster growth. Rich countries may be positioned to succeed in resource management since they have proved, by being developed, that they have well functioning institutions. Similarly, Mikesell (1997) put forward policies for avoiding the Dutch Disease, which, again, have a higher probability of being implemented in rich countries. In

essence, the literature agrees that in order to escape the curse a resource-rich country must be able to deal with distributional conflicts that arise with the discovery of something valuable and be flexible enough to handle the general-equilibrium effects that ensue when production and extraction begins, expands, and contracts. Leamer et al. (1999) tell a story about the lack of such flexibility, found in developing economies, and center the story around the general equilibrium mechanisms that show how resource abundance in Latin America determined a certain capital allocation and development path that may not have been conducive to growth. Norway seems to have done the opposite: it used oil riches to grow.

This article examines Norway's growth performance by measuring its relative performance in the economically, politically, linguistically, and culturally homogeneous Scandinavia. The Scandinavian neighbors are used as yardsticks against which the development is measured. This is made possible because of the similarities between the countries; similarities that had made Scandinavian countries develop in the same fashion for decades, if not centuries. Norway had trailed its neighbors, but nevertheless had experienced much the same growth pace as its neighbors until the early 70s. Then something happened. Norway started to sell oil.

I use neighbor countries obtain a control-group counterfactual in this natural experiment: The ways Denmark and Sweden grew point towards the most probable trajectory Norway *would have grown* had it *not* found oil. The similarity was broken in 1969 when Norway found a resource treasure while Denmark and Sweden did not. About 15 years later, it had caught up with and started to forge ahead of its neighbors. All of a sudden, Norway grew at a different pace compared to its neighbors. From these facts, two all-important questions emerge: Did Norway start catching up *after* having found oil? Did Norway *continue* its relative growth after oil had permeated the economy? The answers shed light on how an industrialized country handles a large resource gift and thus illuminate whether Norway caught the curse.

I answer "yes" on the former question, and believe that this helps identify oil as the cause for the acceleration leading to catch-up. I also offer a "yes" on the latter, given that the period in question is limited to a quarter of a century. This modification is needed because Norway appears to grow fast for an extended period, but then experiences a relative slow-down sometime after 25 years, which opens up the possibility that even industrialized countries may catch the curse after the political and popular pressure has eroded the resistance of economic institutions.

Let me say in advance where I am headed. The next section discusses some preliminary issues concerning comparative growth, structural breaks, and alternative development trajectories. It explains why I use Scandinavian neighbors as control groups in the diagnostic tests. Section 3 introduces the underlying theoretical framework for comparing relative economic development and the method for assessing it empirically. The identification of structural breakpoints is explained. Section 4 presents the empirical evidence. Section 5 discusses briefly possible explanations of why Norway succeeded in managing oil for a substantial period. Section 6 concludes and put forward policy implications. In an appendix, I describe the data set, present regression estimates and further results, and outline the bootstrap algorithm I used in simulating thresholds for statistical inference.

2. Why Scandinavia is an especially interesting natural experiment

Forty years ago, Norway offered less attractive economic circumstances to its citizens than its immediate neighbors. Economic indicators show that Norway at the time was no remarkable place. Most important, gross domestic product per capita was significantly lower than it was in Sweden and Denmark, as Figure 1 depicts. By the turn of the century, the positions were reversed. Today, Norway is in the lead, with Sweden and Denmark lagging. In the meantime, oil was discovered off the Norwegian coast.

Figure 1. GDP Per Capita, Scandinavia, 1960-2002, U.S. 1999 Dollars, PPP

GDP Per Capita, Scandinavia, 1960-2002
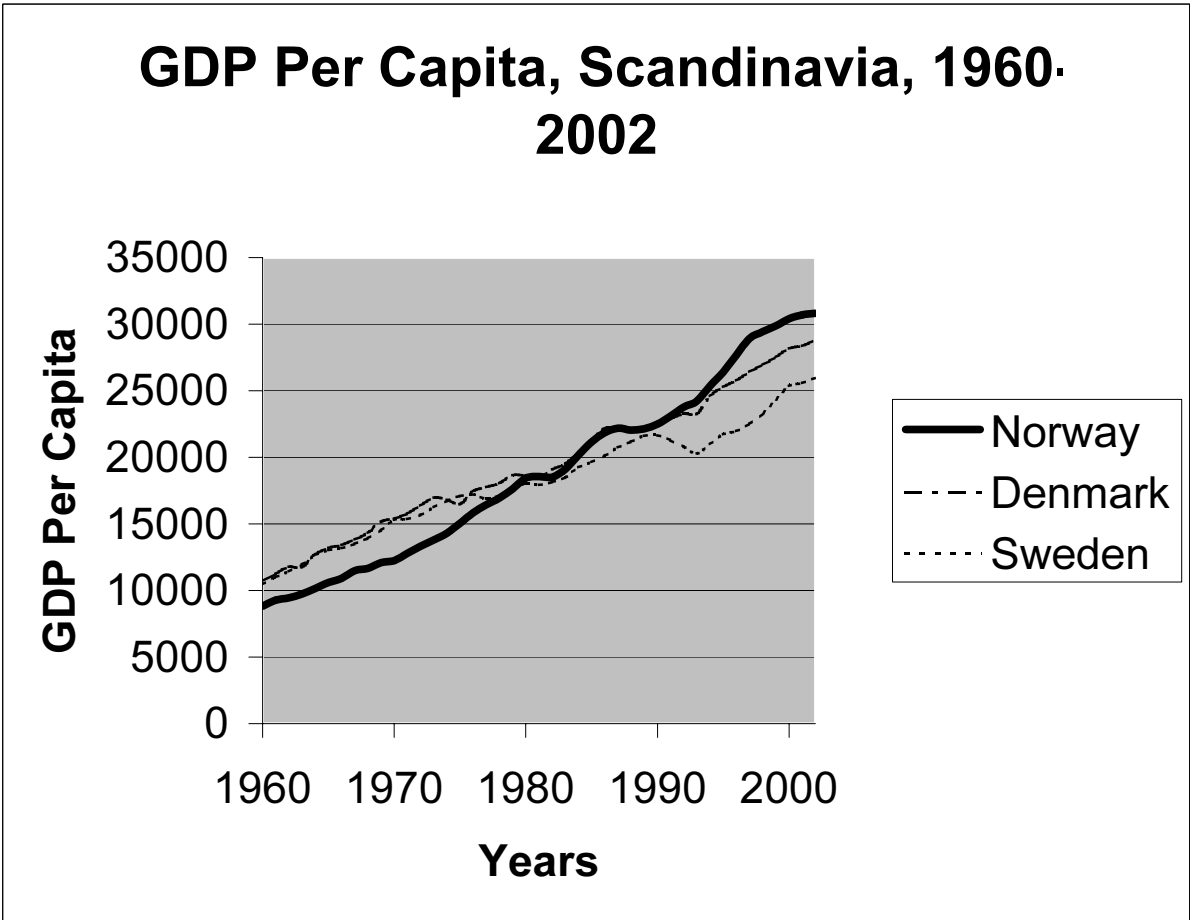
Note: Data from BLS (2003), Table 1. Available online: http://www.bls.gov/fls.

The chronology of these two events, oil discovery and relative acceleration, is especially interesting when it occurs in a country that is so similar to its neighbors, and when these neighbors have not had the same lucky strike nor have had the same spectacular growth. Of course, if analysts examine the history of Norway's growth alone, they would wonder whether there was some other cause than oil that could account for the rise in GDP per capita, even if the acceleration happened at the same time oil revenues started to rise. Such causes could be the implementation of general policies or the entrance of women in the labor force. However, because Denmark and Sweden are highly similar to Norway, and because the three countries have followed each other's growth performance for decades, if not centuries, they may function as control groups.

Denmark, Sweden, and Norway not only are culturally similar, they also share a common political history. The three languages are mutually understood, the labor force is quite mobile within the Scandinavian area, and economic institutions are nearly identical. In addition, requiring, as I explain

below, that Norway first show acceleration then deceleration in comparison to its neighbors, turn out to be a stronger requirement than the an escape from the curse may need. This is so because both Sweden and Denmark also grow fast over the period. The Scandinavian countries were among the top 8 in the world in 1960 with rankings for Denmark, Sweden, and Norway at 4th, 5th, and 8th. In 2002, they were among the top 6 with rankings 4th, 6th, and 2nd. Technically, Norway would qualify as having suffered from a resource curse in a Sachs and Warner sense if its GDP per capita growth went into the reverse sometime after oil extraction began. Here, however, I put Norway into the category of a cursed economy only if it passes certain growth tests. These tests are designed to reveal a counterfactual: whether Norway grew *less than it is reasonable to believe it would have grown without oil,* i.e. less than its' similar neighbors have grown. This seems to be a more intuitive check for whether oil is a blessing or curse. In the case of the natural experiment Norway was subjected to, observers are fortunate in being able to observe the growth also of the two similar neighbors and this opportunity must be exploited.

If this article should be able to substantiate that the onset of Norwegian catch-up really started *before* oil reserves were exploited, such a finding would be inconsistent with an oil-alone explanation of rapid Norwegian growth. If, however, the catching up can be demonstrated to have started *after* Norway acquired oil revenues, it is consistent with an oil explanation of growth. Norway was then a curse candidate after a resource-based growth. If Norwegian performance some time after an oil-fueled acceleration shows signs of a (relative) deceleration, such a development would be consistent with a resource curse phenomenon. Conversely, if there are no signs of deceleration even many years after the oil discovery, we may argue that we are witnesses to an escape from the curse.

3. Theoretical framework for locating relative acceleration and deceleration

This article uses one indicator of economic development in each of the three Scandinavian countries Denmark, Norway, and Sweden: gross domestic product (GDP) per capita converted to U.S. 1999 dollars using purchasing power parity; see Bureau of Labor Statistics (2003). I denote by y_t the gross domestic product per capita in Norway in year t. The variables x_t and z_t represent the gross domestic product per capita in year t of Denmark and Sweden, respectively. Let the differences $\delta_1^t = y_t - x_t$ and $\delta_2^t = y_t - z_t$ represent the differences between the gross domestic product per capita in Norway in year t and the corresponding gross domestic product per capita in Denmark and Sweden. When Norway is lagging, the differences are negative. When Norway is at parity, the differences are zero. Differences become positive when Norway is leading.

Consider as null hypothesis a first-order autoregressive linear development process of the differences between Norway and its neighbors, δ_1^t and δ_2^t, as presented in equations (1)-(3).

(1) $\delta_i^t = \alpha_i + \beta_i t + e_i^t, \qquad i \in \{1,2\}, t \in T,$

(2) $e_i^t = \phi e_i^t + \varepsilon_i^t, \qquad i \in \{1,2\}, t \in T,$

(3) $\varepsilon_i^t = IN(0, \sigma_i^2), \qquad i \in \{1,2\}, t \in T,$

in which the parameters α and β represent the structure of the governing trend mechanisms for the inspected differences between Norway and Denmark and Norway and Sweden; subscripts i and j refer to the two inspected differences; and times t and s are years within the full period T. The e's represent error terms that are governed by a first-order autoregressive process in which the error term ε is identically and normally distributed with zero mean and constant variance σ^2. The autoregressive parameter is denoted by ϕ. Under the null, the process is said to be *difference stationary*, consisting of a sum of two parts. The first part is a deterministic time trend, and the second part is a difference-stationary process in which the white noise is provided by the stationary error term ε. Equation (1) tells us that any change in intra-Scandinavian economic position follows a trend pattern where the governing parameters are constant over the period. In this model, an oil discovery makes no difference.

Consider now the alternative model in which an oil discovery could lead to acceleration, deceleration, or both. In the problem at hand, both a level effect and a pace effect could occur in the relative intra-Scandinavian economic development. A level effect would manifest itself in the intercept, and could e.g. be due to sudden reaping of oil riches in Norway. A pace effect would be observable in the slope, and could e.g. be caused by oil-induced accelerated growth. These possibilities are exemplified in equations (4)-(6) for the special case in which there is one break.

(4) $\delta_i^t = \alpha_i + \beta_i t + u_{1i}^t, when \quad t < b, and \quad \delta_i^t = (\alpha_i + \kappa_i) + (\beta_i + \lambda_i)t + u_{2i}^t, when \quad t \geq b, i \in \{1,2\}, t \in T,$

(5) $u_{ki}^t = \phi_{ki}^t u_{ki}^{t-1} + \varepsilon_{ki}^t, \qquad i, k \in \{1,2\}, t \in T,$

(6) $\varepsilon_{ki}^t = IN(0, \sigma_{ki}^2), \qquad i, k \in \{1,2\}, t \in T,$

in which the level effect is captured by κ_i and the pace effect λ_i, subscript k denotes period, of which there are two possibilities: before and after the unknown breakpoint year b. The subscript i refers to country difference, of which there are two kinds: Norway vs. Denmark and Norway vs. Sweden. The error terms u, within difference type i and period k, are identically and independently distributed with zero-mean and constant variance. In the remainder I shall scrutinize models (1)-(3) and (4)-(6) empirically, and investigate whether the differences between the Norwegian GDP per capita and the GDP per capita of each neighbor follows a pattern in which the level and slope effects κ_i and λ_i are negligible at any and all suggested breakpoint years or particularly acute at possible candidate breakpoint years. In particular, I shall follow the idea that there may be a first breakpoint year b such that Norwegian development accelerates and possibly also second breakpoint year c, after Norway has caught up with the neighbors, such that the Norwegian development decelerates. The scores on these examinations, then, constitute a diagnostic test of the presence of a resource curse.

In order to compare models (1)-(3) and (4)-(6), I employ structural break analysis; as described e.g. by Hansen (2001); and tabulate a sequence of test statistics constructed to capture structural breaks in time series. I first break the full period T, 1960-2002, into two periods: before and after candidate breakpoint years b, that obviously occurs before parity. I successively vary the breakpoint over a range of candidate years of acceleration from 1965 to 1982. If one linear trend governs the full period, as stated by the null hypothesis, there is nothing to gain in explained variation and increased fit by dividing the period into two. Conversely, if the null is false, there is much to be gained by dividing the period into two, and repeatedly searching over candidate years will reveal the most optimal breakpoint year. That year has the highest computed F-ratio. After parity, which is found to occur in the 80s, I search for deceleration. This search is performed on candidate years in the period 1980-1997.

In this study, I have simplified the alternative to be limited to two one-time breaks, one before parity and one after, corresponding to the search for an acceleration and a deceleration. I see at least one compelling reason for doing this. From a theoretical point of view, the most interesting case in light of this article's purpose lies in whether there is none or at least one breakpoint of acceleration before or after oil revenues are generated, and none or at least one breakpoint of subsequent deceleration. Given that there is at least one, it is less interesting to our purpose whether there is at most one or several. The idea is that a curse will manifest itself first as an accelerated catch-up, then in a deceleration from a maximum difference between the Norwegian GDP per capita and those of its neighbors. Regardless of the speed of descent from this year -- the year of maximum difference -- a descent will be detected by the structural break technique because the estimated slope will have different signs before and after

the year of maximum difference. The candidate breakpoint year itself may be identified as the year in which the F-ratio, given by equation (7), reaches a maximum:

(7) $\qquad F = [(RSS_R - RSS_U)/r]/[(RSS_U/(n-K)].$

In equation (7), RSS denotes the sum of squared residuals, the subscripts R and U represent the restricted and unrestricted case, respectively; r the number of linear restrictions; n the number of observations; and K the number of parameters in the unrestricted case. I examine a series of F-ratios for two sub-periods, before and after the breakpoint year, for two types of searches, acceleration and deceleration before and after parity, so r will be equal to 3 for each type of search since the null hypothesis entails restricting intercept, slope, and autoregressive factor to be equal for both sub-periods. In other words, the restricted model (the null hypothesis), requires level, slope, and the autoregressive factor to be identical for both periods. The unrestricted case allows both different levels and different slopes for the period before the breakpoint year and after, reflecting oil's possible level and slope effect, in addition to allowing for a change in the autoregressive process. Notice that K equals 6 in the unrestricted case since in feasible general least squares, a constant, a slope, and an autoregressive factor are estimated for both sub-periods. In the appendix, I include an explanation of how to make inferences and perform hypothesis tests after having scrutinized the data. To make inferences, I use bootstrap Monte Carlo simulation schemes that estimate critical thresholds for rejecting the null.

First, the article identifies when economic parity occurred between Norway and both neighbors. To this end, I use a broad assessment method. It involves locating the last time t_L all preceding Norwegian GDP per capita were smaller than the Danish and Swedish equivalents. In addition, we locate the time t_F, after which all Norwegian gross domestic products per capita were larger than the Danish and Swedish equivalents. This will yield an interval in which the Norwegian gross domestic products alternated as being smaller or larger than those of the neighbors. The period of parity functions as a mark for when to search for breakpoints of acceleration and deceleration.

Second, and more importantly, I search for these structural breaks. I limit my search to two: one of acceleration and one of deceleration. The idea of a smooth, non-oil related relative acceleration and eventual catch-up and passing is manifested by a pattern in which the differences δ_1^t and δ_2^t follow a linear progression through the full period. This development may have started before the oil discovery. The alternative idea, an abrupt, oil-related, relative acceleration and the onset of a sudden, possibly

curse-related, relative deceleration would show up such that differences in GDP per capita do not to follow a linear progression through the observed period. In stead, there will be one or several structural breakpoints, discontinuities or regime changes, after which the differences follow a different path until a new break occurs. These ideas may be written rigorously and tested statistically using structural breakpoint analysis. To the best of my knowledge, it is the first time structural breakpoint analysis is used in this fashion for relative change of pace in testing for resource curse.

4. Empirical Results

An empirical pattern emerges when the structural break technique is applied to data. Norway accelerated GDP per capita relative to its neighbors after the oil discovery. It then did not for a long while suffer from a resource curse, as we can find no relative retardation for the next two decades. Instead, Norway grew at least as fast as its similar and close-by neighbors. However, there exists an intriguing slow-down late in the period, after mid-90s, possibly symptomatic of an on-set of relative retardation.

Table 1 tabulates estimated parameters that constitute the overall impression relative to Denmark. For the period 1960-2002, Norway grew faster than Denmark did. First, we do observe that the autoregressive process seems in order since there is a large difference between the regression R-squared and the total R-squared, indicative of AR-1 presence. But more importantly, for each year the trend seems to portray a stronger Norwegian annual growth, of magnitude 110 U.S 1999-dollars compared to that one of Denmark.

Table 1. **Estimates for Null Hypothesis, Norway vs. Denmark, 1960-2002 and 1975-2002, First Order Autoregressive Regression**

Parameter	Parameter Estimates, 1960-2002 (t-values)	Parameter Estimates, 1975-2002 (t-values)
Intercept, α	-2787 (-4.47)	-3624 (-6.50)
Time Coefficient, β	110.0146 (4.68)	140.4360 (7.55)
Autoregressive Factor, ϕ	-0.8735 (-12.08)	-0.6748 (-4.59)
Number of observations, N	43	28
Regression R-squared	0.3538	0.6951
Total R-squared	0.9603	0.9430
Sum of Squared Errors	5305087.48	2520669.73
MSE	132627	100827
Durbin-Watson	1.575	1.5429

Note: Total R-squared is unity minus the ratio of sum of squared errors between model predictions and original observations to the sum of squared differences between the original observations and their mean. The regression R-squared is unity minus the ratio of sum of squared errors between model predictions and the AR-1 transformed response variables to the sum of squared differences between the transformed response variables and their mean. The large difference between the two R-squared measures indicates presence of an AR-1 process that has been accounted for.

Figure 2 shows the profile of a structural break. It means that while the overall impression is that Norway grew faster than Denmark over the full period, there is a marked difference in pace between periods. This shows up in Figure 2 as a peak in F-ratio, caused by the fact that splitting the sample into one 1960-1974 period and one 1975-2002 period greatly enhances fit compared to retaining a full 1960-2002 period. For breakpoint candidate years 1974 and 1975, the estimated F-ratios for the restricted null hypothesis versus the unrestricted alternative are 5.52 and 6.81 while the bootstrap simulated 99th percentile of the F-ratio distribution is 4.83. In other words, rejecting the null involves committing type-I-errors less than 1 percent of the time. Thus, we do reject the null, and make the inference that Norway's development in GDP per capita accelerated relative to Denmark's in the mid-70s, only a few years after oil extraction had begun. In the appendix, a figure depicting Norway's development compared to Sweden shows a similar, but somewhat earlier, acceleration.

Figure 2. Structural Break, Relative Performance in GDP/cap, Norway vs. Denmark, Candidate Years: 1965-1982

Testing for Structural Break, Norway vs Denmark, Full Period: 1960-2002, Candidate Years: 1965-1982
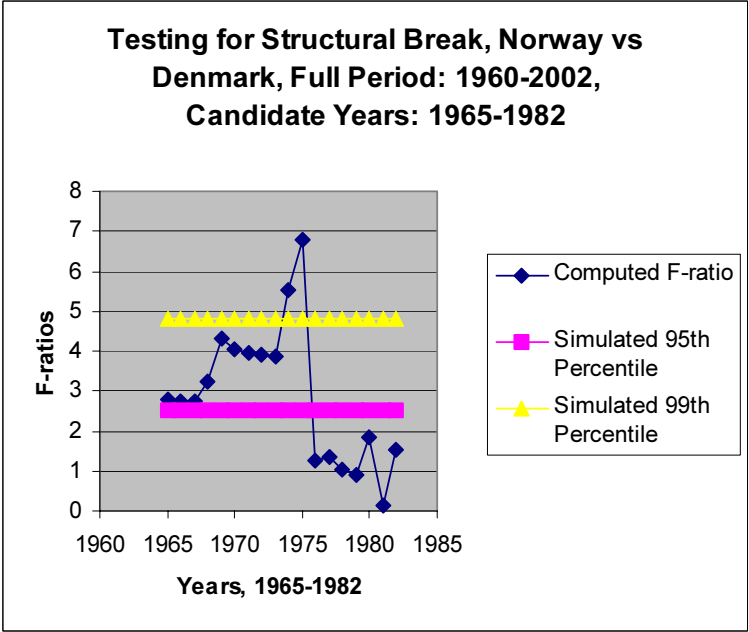
Note: Maximum likelihood estimation, AR-1 process.

Figure 3. Structural Break, Relative Performance in GDP/cap, Norway vs. Denmark, Candidate Years: 1980-1997

Testing for Structural Break, Norway vs Denmark, Full Period: 1975-2002, Candidate Years: 1980-1997
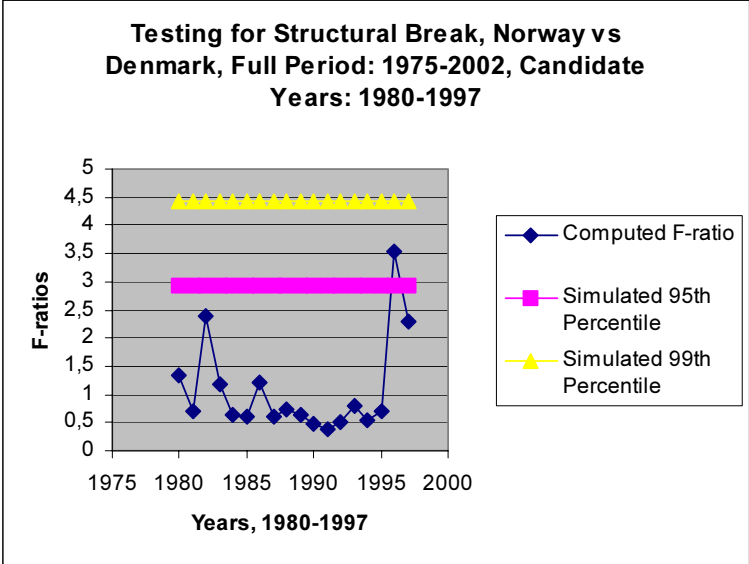
Note: Maximum likelihood estimation, AR-1 process.

In contrast, Figure 3 shows that for the next two decades there seems to be no obvious breakpoint year. Instead, the relative growth process appears to follow the same structure. In other words, Norway does

not accelerate further compared to Denmark nor does it experience a relative retardation. In this period, the development is one in which there occurs no slow-down. Instead, the period is characterized by a fairly steady development in the relative growth between Norway and Denmark. Norway continues to expand somewhat faster than Denmark, and reaches maximum difference in 1998. Put differently, for a quarter of a century Norway escaped the curse and grew more than it probably otherwise would have.

Intriguingly, Figure 3 shows that there exists an F-ratio peak in 1996. It offers a possible turn of events since Denmark late in the period discovered oil of its own, and became net exporter of oil in the mid-90s. However, as there is a similar relative breakpoint candidate in the appendix figure for Sweden, we rule out a unique Danish spurt. Rather, the development may be interpreted as that of a Norwegian relative slow-down, which thereby invites allowing for a late on-set of a resource curse. To illustrate, the estimated slope of growth between Norway and Denmark for the remainder of the period turned negative in 1996, for the first time. Relative to Sweden, the estimated slope turns negative in 1995 for the first time. Obviously, 1996-2002 and 1995-2002 are short periods, so few observations do not yield many degrees of freedom, and thus preclude a satisfactory degree of accuracy in the estimates. However, the shifts of signs in the estimates, rather than the magnitudes of the estimates, make us suspicious of a possible, but modest, curse. Let us make a closer inspection of the GDP per capita numbers.

We observe that Norway reached maximum lead over Denmark in 1998, in which the difference in GDP per capita was of magnitude 2 506 U.S. 1999 dollars, and maximum lead over Sweden in 1997, in which the difference was 6 431 U.S. 1999 dollars. After that, the lead diminishes, and is reduced to 2 007 and 4 837, respectively, in 2002.

Of course, such a structural break could be caused by a marked reduction of oil and gas revenues. But the *volume* of Norwegian oil extraction did not fall in this period. On the other hand, the *price* of oil did fall in 1998, and it fell remarkably (about 30 percent). Thus, it could be possible that nothing in the real production in Norway changed, only world prices of that very same production. If that were to be the case, it would not justify using the curse term.

In Figure 4 I plot what fraction of the *value* of the extraction and sale of the natural resources oil and gas constitutes of GDP in Norway for the period 1988-2002. The figure shows a dip at the end of the 90s. However, this reduction has been compensated for in recent years, and the value share of oil has

risen. That means that it cannot be the disappearance of oil revenues that explains the relative Norwegian retardation. In fact, even if oil prices dropped in the year 1998, they have risen sharply since. Rather, the relative slow-down in Norwegian aggregate performance after the mid-90s indicates that Norway might not have escaped the resource curse after all.

Figure 4. The Importance of North Sea Oil and Gas, Fraction of GDP, Market Value, Norway, 1988-2002
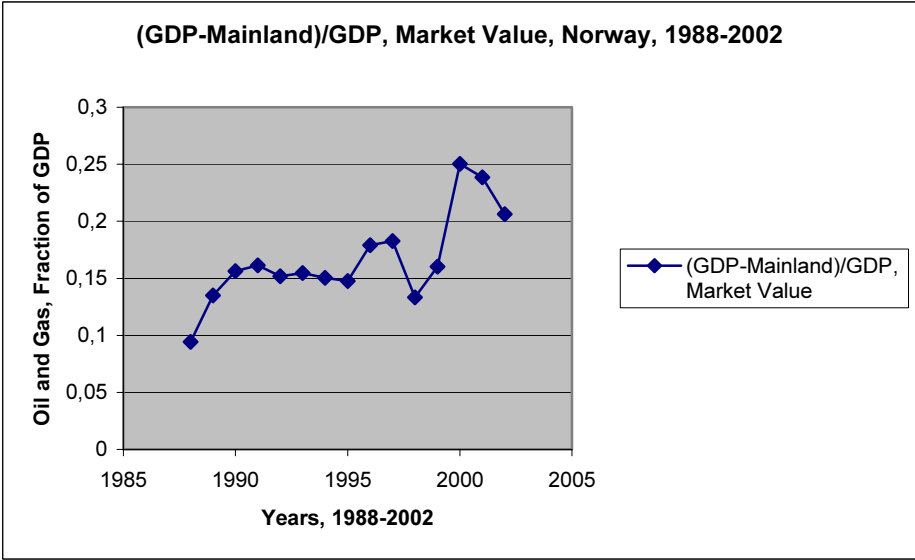
Source: National Accounts, Statistics Norway.

In short, these findings may be summarized as tabulated in Table 3. Norway accelerated in the early-70s, probably due to increased sales of the valuable commodity oil. It then continued to grow relative to its neighbors, defying the curse. This relative growth first led to a catch-up, then to a forging ahead of its neighbors. Norway did not show any signs of a curse for a quarter of a century. However, in the late 90s Norway no longer experiences faster growth than Denmark and Sweden. Instead, the trend has gone into reverse and Denmark and Sweden now grow faster than Norway. Notice, however, that Norway's GDP per capita still grows, so it suffers from a relative, not absolute, slow-down in growth in GDP per capita.

Table 2. Summary of Tests for Presence of Resource Curse

Comparison Country	Acceleration First 5 Years after Oil Discovery	Retardation Next 20 Years	Retardation After 25 Years
Norway vs. Denmark	Yes	No	Possibly
Norway vs. Sweden	Yes	No	Possibly

5. Why Did Norway Escape the Curse for So Long and Will It Finally Suffer from It?

Having established that Norway escaped the curse for a quarter of a century leads to the question of how. This is a particularly acute question since so many countries have fallen victims to the curse. If luck is the answer, then we need no further examinations since it cannot be replicated. However, if policy, institutions, and favorable initial conditions are part of the answer, we may pay keen attention since they are replicable. We observe that Norway may have finally caught a milder version of the curse late in the period. This also begs the question of why. Was it inevitable or self-imposed? But answering how and why presupposes the existence of an accepted framework within which to understand growth. This framework is absent, and its absence complicates attempts at offering exhaustive and satisfactory explanations. Sachs and Warner summarize the challenge: "Just as we lack a universally accepted theory of economic growth in general, we lack a universally accepted theory of the curse of natural resources." However, the short explanation offered here, based on the institutional approach in e.g. Abramovitz (1986), Eichengreen (1996), and Rodrik (1995, 1997), is that Norway avoided the curse for so long because it had well-suited political and economic institutions in place that ensured that the economy could be properly shielded from the oil revenues. The spending and displacement effects were moderated. In addition, there existed popular support for the strategy of protecting the economy. However, Norway may have caught a milder form of the curse, finally, because of the tremendous political and popular pressure that mounted when citizens observed the juxtaposition of a build-up of large petroleum funds abroad alongside unattended-to needy causes domestically. At the turn of the century, politicians and the public strongly wanted to tap into these vast funds, and bring them into the home economy regardless of whether they would displace private, industrial export activities.

Let me attempt a brief outline of the story most often told about the Norwegian success two-decade-long success. This outline will build on, and is a synthesis of, such studies as Barth and Moene (2000),

Bjørnland (1998), Brunstad and Dyrstad (1997), Cappelen, Eika, and Holm (2000), Hutchison (1994), Hægeland and Møen (2000), Sachs and Warner (1999), Torvik (2001) and Wallerstein (1999). Norwegian institutions and policy makers managed to make oil a blessing in the 70s, 80s, and early 90s. This was achieved through a complex mix of policies, not all consistent with neoclassical policy prescriptions, that prevented the economy from overheating, yet managed to achieve full employment in addition to minimizing manufacturing displacements, reducing wage pressure through income coordination, and stimulating productivity. Implementation of this policy strategy was possible since the resources were publicly owned and publicly managed. Social norms, centralized wage formation, and an affinity towards equality ensured that the populace rested assured that the oil wealth would be distributed equitably. This prevented disrupting rent seeking, and created a sense of social contract that promised that everybody would eventually reap the benefits from oil.

Norway embarked early in the 1970s on an ambitious combination of general policies. First, it used price subsidies, transfers, and tariffs to shield and support certain domestic industries thought to be crucial to a long-term comparative advantage. Second, it invested heavily in education and know-how. Third, it followed counter-cyclical polices to increase the share of employed laborers in the labor force, and did so probably much more enthusiastically than would have been feasible without oil resources. Fourth, labor market reforms were implemented to increase the labor force's share of the population. Fifth, wage control and income coordination programs were followed in nation-wide negotiations. The programs fell into an umbrella framework later named "The Solidarity Alternative" and helped establish the sense of social contract. Sixth, an expenditure-limitation policy of fiscal prudence directed to shield the economy from spending effects was institutionalized through the establishment of the Petroleum Fund and the so-called "Usage Rule" that limits exploitation of the fund to annual four percent returns of the Petroleum Fund. The last two were made possible by the fact that Norway has the most compressed wage-negotiating system of industrialized countries and wide public support for an equality of pay; see Wallerstein and Barth and Moene.

As oil receipts were not converted into kroner and brought home, the receipts were instead kept in foreign denominations and used to build up the Petroleum Fund in assets abroad. During the 90s, this fund increased to large fractions of the GDP, and with it public pressure to use it. There emerged a growing sense of wealth, and a populace that believes it is wealthy, but keeps observing needy causes, appeared to demand money. So the Usage Rule has recently in effect been put aside, and oil reserves in excess of four percent returns have been used to purchase public goods, and thereby to command a growing percentage of the approximately 3 000 million labor hours available in Norway each year.

17

This growing public sector is not as productive as the older, private industrial export base, from which it attracts labor, and hence the growth of the value of Norwegian GDP experiences a relative deceleration. Moreover, this public sector does not export. This new development in Norwegian performance is hitherto unexplored in the literature.

6. Concluding Remarks and Policy Implications

Norway enjoyed newfound riches in the early 70s, and its GDP per capita grew fast. It also became a candidate for contracting the resource curse, but appears to have escaped it for two decades. A curse would have made itself evident by first leading to an oil-driven acceleration of the value of aggregate output, then followed by a subsequent deceleration. Using a structural break technique this article demonstrates that Norway accelerated without decelerating for a quarter of a century, compared to highly similar Scandinavian neighbors. These neighbors highlight the probable counterfactual path of how Norway would have developed *without* oil.

The reasons why Norway escaped the curse are multifaceted. Since there is no consensus on what causes growth in general there is no readily applied framework to explain Norway's escape straightforwardly. I build on other works when I argue that conflicts of distribution were avoided because the revenues were publicly controlled and evenly distributed. Legal and illegal confiscations of rents were difficult in a transparent and accountable bureaucracy at the same time as a popular social contract and strong social norms helped to prevent time-consuming and disruptive rent-seeking. As a consequence, Norway's aggregate output grew to one of the highest in the world.

Norway thus seems to be a country that not only survived an era of sudden oil riches with the basic economic structures intact, but also a country that utilized the riches to grow, for a long while. This may support the suggestion that the resource curse only afflicts poor countries. I hypothesize that at least three fundamental factors have contributed to this success. First, Norway was in a favorable position to find oil. An educated populace could start an intensely technological extraction that also gave birth to build-up of expertise and spillovers into innovative research. Second, well functioning political and economic institutions helped secure a sustainable path of economic development. Third, the valuable export commodity created large receipts that helped finance further investments into know-how and technology. To the extent that developed countries share these qualities, it may be possible that developed countries are less likely to contract the curse. However, some facets are not necessarily easily replicated. Norway is a special case in its fervently egalitarian society that has cultivated strong social norms of equality and solidarity. This may have prevented pressure from

vested interests in rent-seeking and allowed a centralized government to follow long-term plans. Norway's oil policy was, for a while, patient, realistic, and modest.

But, nevertheless, the success may have fed its own demise. Along with a build-up of vast oil reserves abroad, denominated in foreign currencies, grew domestic discomfort and impatience. People observed the fortunes expand, and found many tasks that needed to be done. There appeared a sensation that there were no limits to the Norwegian wealth, so there should exist no want. Thus, pressure increased on politicians to promise remedies, and the suggestions involved utilization of oil money. Symptomatically, this article detects a possible structural break late in the 90s, in which Norway reached maximum lead over its neighbors and started a relative descent. This may be the on-set of a mild resource curse. Only time will show if the neighbors Denmark and Sweden once again pass, and Norway is struck with a full-blown resource curse, despite its good institutions and well-designed policies.

Finally, this article offers an interesting twist on its own premises. It claims that Norway experienced a growth path different from its otherwise similar neighbors because Norway was unique in its position as a large oil exporter. It shall be interesting, then, a few decades from now to assess Denmark's development. Denmark has recently started its own oil production, and production passed own consumption in the mid-90s, rendering Denmark as a net exporter. Even if production in 2003 is only about one tenth of that one in Norway, after some years have passed it will be possible to test the empirical regularities detected here, and the validity of the explanations I have put forward. In short, if this article is right, Danes should escape the resource curse for a while since they have the same institutions in place as the Norwegians had. Thus, Denmark should be well posed to pursue identical, successful oil-management policies. But, as Norway, they may not be immune to the Resource Curse in the long run.

References

Abramovitz, M. (1986): Catching Up, Forging Ahead, and Falling Behind, *Journal of Economic History*, **46**: 2, pp. 385-406.

Andrews, D. W. K. (1993): Tests for Parameter Instability and Structural Change with Unknown Change Point, *Econometrica*, **61**:4, pp. 821-856.

Andrews, D. W. K. and W. Ploberger (1994): Optimal Tests When a Nuisance Parameter is Present Only Under the Alternative, *Econometrica*, **62**: 6, pp. 1383-1414.

Auty, R. M. (2001): The Political Economy of Resource-Driven Growth, *European Economic Review*, **45** (4-6): 839-846.

Baland, J.-M. and P. Francois (2000): Rent-seeking and Resource Booms, *Journal of Development Economics*, **61**, pp. 527-542.

Barth, E. and K.O. Moene (2000): Er lønnsforskjelle for små? [Are Wage Differences Too Small?], in NOU 21: *En strategi for sysselsetting og verdiskaping*, Vedlegg 3, Oslo: Norges Offentlige Utredninger.

Bjørnland, H. C. (1998): The Economic Effects of North Sea Oil on the Manufacturing Sector, *Scottish Journal of Political Economy*, **45**: 5, pp. 553-585.

Brunstad, R. J. and J. M. Dyrstad (1997): Booming Sector and Wage Effects: An Empirical Analysis on Norwegian Data, *Oxford Economic Papers*, **49**: 1, pp. 89-103.

Bureau of Labor Statistics (2003): Comparative Real Gross Domestic Product Per Capita and Per Employed Person. Fourteen Countries, 1960-2002, U.S. Department of Labor. http:www.bls.gov/fls

Cappelen, Å., T. Eika, and I. Holm (2000): Resource Booms: Curse or Blessing? manuscript presented at the Annual Meeting of American Economic Association 2000?, Oslo: Statistics Norway.

Chow, G. C. (1960): Tests of Equality Between Sets of Coefficients in Two Linear Regressions, *Econometrica*, **28**: 3, pp. 591-605.

Eichengreen, B. (1996): Institutions and Economic Growth: Europe after World War II, in N. Crafts and G. Toniolo (eds.): *Economic Growth in Europe Since 1945*. Cambridge: Cambrigde University Press, pp. 38-72.

Gylfason, T. (2001): Natural Resources, Education, and Economic Development, *European Economic Review*, **45**, pp. 847-859.

Hansen, B. E. (2001): The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity, *Journal of Economic Perspectives*, **15**: 4, pp. 117-128.

Hutchison, M. M. (1994): Manufacturing Sector Resiliency to Energy Booms: Empirical Evidence from Norway, the Netherlands, and the United Kingdom, *Oxford Economic Papers*, **46**: 2, pp. 311-329.

Hægeland, T. and J. Møen (2000): Kunnskapsinvesteringer og økonomisk vekst (Investments in Knowledge and Economic Growth), in NOU 2000: 14 *Frihet med ansvar*, Vedlegg 15, Oslo: Norges Offentlige Utredninger.

Mikesell, R. F. (1997): Explaining the Resource Curse, with Special Reference to Mineral-Exporting Countries, *Resources Policy*, *23*: 4, pp. 191-199.

Paldam, M. (1997): Dutch Disease and Rent Seeking: The Greenland Model, *European Journal of Political Economy*, **13**, pp. 591-614.

Quandt, R. (1960): Tests of the Hypothesis that a Linear Regression Obeys Two Separate Regimes, *Journal of the American Statistical Association*, **55**, pp. 324-330.

Rodrik, D. (1997): The 'Paradoxes' of the Successful State, *European Economic Review*, **41**, pp. 411-442.

Rodrik, D. (1995): Getting Interventions Right: How South Korea and Taiwan Grew Rich, *Economic Policy*, 20, pp. 53-97.

Sachs, J. D. and A. M. Warner (2001): The Curse of Natural Resources, *European Economic Review,* **45**, s 827-838.

Sachs, J. D. and A. M. Warner (1999): The Big Push, Natural Resource Booms and Growth, *Journal of Development Economics*, **59**, pp. 43-76.

Stevens, P. (2003): Resource Impact: Curse or Blessing? A Literature Survey, *Journal of Energy Literature*, **9** (1), pp. 3-42.

Torvik, R. (2001): Learning by Doing and the Dutch Disease, *European Economic Review*, **45**, pp. 285-306.

Wallerstein, Michael (1999): Wage-Setting Institutions and Pay Inequality in Advanced Industrial Societies, *American Journal of Political Science*, **43**: 3, pp. 649-680.

A. Data and Estimation Method

Real GDP per capita converted to U.S. 1999 Dollars using a technique involving purchasing power parity can be found in Table 1 at page 9 in "Comparative Real Gross Domestic product Per Capita and Per Employed Person. Fourteen Countries. 1960-2002", U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology, July 2003. Online access is possible through the web page: http://www.bls.gov/fls/.

Gross domestic products measured in national currencies are converted to comparable entities using purchasing power parity (PPP). For a given country, a ratio is computed that consists in the numerator of the monetary units needed to purchase a common basket of goods and in the denominator the monetary units needed to purchase the basket in the United States. This ratio is then used to compute an international equivalent of a country's gross domestic product.

Results here are based on maximum likelihood estimation of first-order autoregressive processes. I also experimented with Yule-Walker estimation method, and performed analyses based on trend-stationary processes and second-order autoregressive processes. The overall empirical regularities were maintained, and the breakpoint years did not vary substantially over estimation method or choice of stochastic process. Thus, the identification of the deterministic part seemed fairly robust against several models of the stochastic process.

B. Relative Development, Norway vs. Sweden

Table A1. Estimates for Null Hypothesis, Norway vs. Sweden, 1960-2002 and 1975-2002

| Parameter	Parameter Estimates, 1960-2002 (t-values)	Parameter Estimates, 1975-2002 (t-values)
Intercept, α	-2647 (-2.39)	-5552 (-4.01)
Time Coefficient β	172.8136 (4.39)	265.5349 (5.84)
Autoregressive Factor, ϕ	-0.9211 (-16.64)	-0.8276 (-7.06)
Number of observations, N	43	28
Regression R-squared	0.3252	0.5768
Total R-squared	0.9756	0.9595
Sum of Squared Errors	8924990.76	6652114.96
MSE	223125	266085
Durbin-Watson	0.8889	0.7933

Note: Total R-squared is unity minus the ratio of sum of squared errors between model predictions and original observations to the sum of squared differences between the original observations and their mean. The regression R-squared is unity minus the ratio of sum of squared errors between model predictions and the AR-1 transformed response variables to the sum of squared differences between the transformed response variables and their mean. The large difference between the two R-squared measures indicates presence of an AR-1 process that has been accounted for. The algorithm did not converge for maximum number of iterations in year 1967.

Figure A1. Structural Break, Relative Performance in GDP/cap, Norway vs. Sweden, Candidate Years: 1965-1982
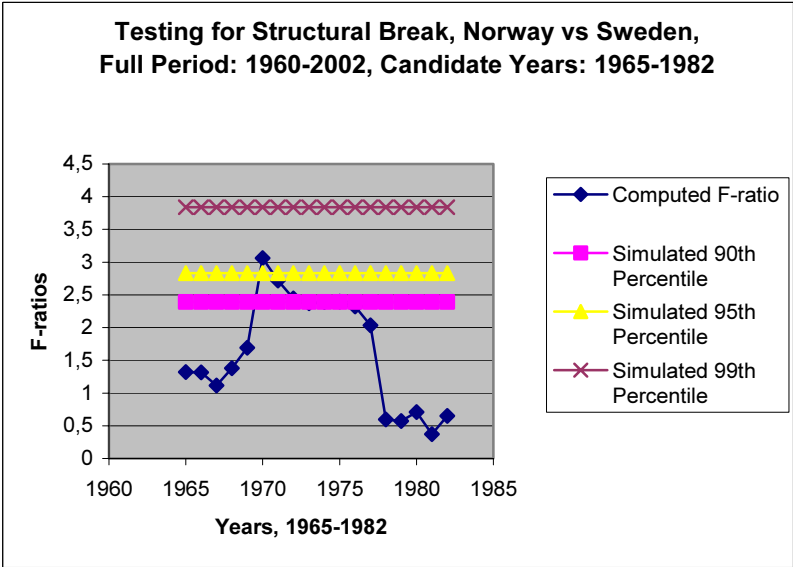
Note: Maximum likelihood estimation, AR-1 process.

**Figure A2. Structural Break, Relative Performance in GDP/cap, Norway vs. Sweden,
Candidate Years: 1980-1997**

Testing for Structural Break, Norway vs Sweden,
Full Period: 1975-2002, Candidate Years: 1980-1997
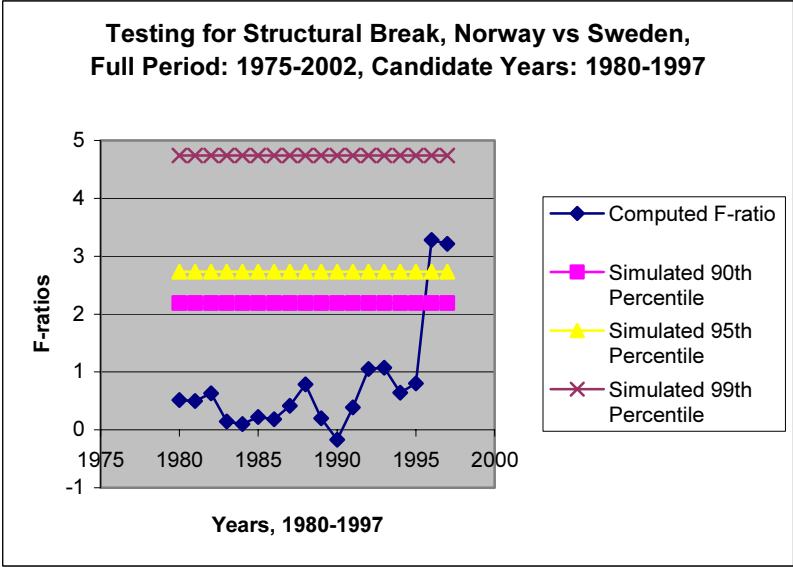
Note: Maximum likelihood estimation, AR-1 process.

C. Bootstrap Simulations

The field of structural breaks in time series is a highly active field of research. Allow a few words on background and modeling choices made in this article. The field emerged when Chow (1960) introduced a methodology to check whether a *given* point was a break point. However, more realistically, analysts do not know a priori which point would be a breakpoint, so Quandt (1960) suggested a more general method, in which the breakpoint was unknown; in essence introducing a search algorithm to find the most likely candidate. The difference between Chow's analysis and Quandt's algorithm is important. If theory leads an analyst a priori to suspect that a given year represents a breakpoint then she may test the null against the alternative for that specific year, and make rigorous inferences from the obtained statistic since the statistic's distribution then would be known. If, however, one searches for a candidate year by looking at data before testing, one cannot a posteriori perform the same test after having identified the most likely candidate because then the analyst does not know the distribution of the test statistic. As Hansen (2001) explains, the fact that the breakpoint is unknown beforehand, but is found by inspecting the data, disallows use of the usual distribution of computed F-statistics. The distribution is different from the statistic of an a priori test, *not* involving data inspection. Andrews (1993) and Andrews and Ploberger (1994) provide tables of critical values based on simulations for tests when data inspection yields candidate breakpoint years. This article, however, performs its own tailor-made semi-parametric Monte Carlo bootstrap simulations of critical thresholds under the null for the observed series of F-ratios since the tables are

not readily available for our purpose. These simulations will allow statistical inference, and the computation of p-levels. Below is included a brief outline of the rationale.

In order to simulate the critical levels of the computed F-ratios, I perform a parametric Monte Carlo bootstrap simulation.

Under the null hypothesis, the full period 1960-1998 is governed by one development mechanism. It consists of a trend and an autoregressive first-order component. By identifying the trend and the autoregressive process through analysis using feasible general least squares (FGLS), we may simulate the thresholds. Under the null, the process runs over the entire time period. To obtain thresholds for the analysis of the relative performance, δ, construct e.g. 500 samples of same size (43 for the full period) as the original sample using the following process:

$$(A1) \qquad \delta_t = \hat{\alpha} + \hat{\beta}T + e_t,$$

$$(A2) \qquad e_t = \hat{\phi}e_{t-1} + \varepsilon_t,$$

$$(A3) \qquad \varepsilon_t = IN(0, \hat{\sigma}_\varepsilon^2),$$

then compute the F-ratios for each sample and obtain 500 simulated F-ratios. The distribution of these 500 simulated F-ratios, computed from each of the 500 simulated samples, simulates the distribution of the original F-ratio. One may then identify the magnitude of the resulting 95th and 99th percentile. For the relative performance of Norway versus Denmark, I simulate thresholds for breaks in 1975 (486 samples) and 1989 (n samples), and use MSE of 132627 and 100827, respectively, in equation (A3). For the relative performance of Norway versus Denmark, I simulate thresholds for breaks in the same years, but of course use the appropriate parameters of the stochastic process, estimated through FGLS on the relative growth of Norway versus Sweden; see e.g. Table A1.

Notice that all such simulations make use of a true null to estimate the probabilities of making type-I-errors, or alpha-levels. It does not estimate beta-levels and power.