CEEPR **Center for Energy and Environmental Policy Research**

Capacity Factor Risk At Nuclear Power Plants

by
Yangbo Du and John E. Parsons

10-016

November 2010
Revision January 2012

A Joint Center of the Department of Economics, MIT Energy Initiative, and Sloan School of Management

CAPACITY FACTOR RISK AT NUCLEAR POWER PLANTS

Yangbo Du[*] *and John E. Parsons*[**]

first draft November 2010
this revision January 2012

We develop a model of the dynamic structure of capacity factor risk. It incorporates the risk that the capacity factor may vary widely from year-to-year, and also the risk that the reactor may be permanently shutdown prior to the end of its anticipated useful life. We then fit the parameters of the model to the IAEA's PRIS dataset of historical capacity factors on reactors across the globe from 1969 to 2010 (i.e., before the Fukushima disaster). The estimated capacity factor risk is greatest in the first year of operation and quickly declines until it is approximately constant through the life of the reactor. We also obtain a relatively low estimate for the mean capacity factor, approximately 73%. We discuss variations on these estimates and emphasize the importance of judgment in making these estimates.

[*] Center for Energy and Environmental Policy Research, MIT, E19-411, 77 Massachusetts Ave., Cambridge, MA 02139 USA, E-mail: yangbodu@mit.edu

[**] Corresponding author: MIT Sloan School of Management, MIT Center for Energy and Environmental Policy Research, and the MIT Joint Program on the Science and Policy of Global Change, MIT, E19-411, 77 Massachusetts Ave., Cambridge, MA 02139 USA, E-mail: jparsons@mit.edu

1. INTRODUCTION

One of the critical risks facing an investor in a nuclear power plant is uncertainty about the plant's realized capacity factor. Realized capacity factors show great variation. Although the typical investor's cash flow model of a proposed plant shows a projected capacity factor of 85% or more, many reactors have problems achieving this target. Oftentimes the shortfall is quite large. According to the Power Reactor Information System (PRIS) database maintained by the International Atomic Energy Agency (IAEA), the realized capacity factor is less than 50% in more than 10% of all reactor years. In one of the countries with the largest nuclear power programs, Japan, the average capacity factor for the three years *before* the Fukushima disaster, 2008-2010, was only 63%. In the US, performance was extremely poor in the 1970s and 1980s. For example, in 1985 the overall capacity factor for nuclear power plants in the US was 58%. Individual reactor performance varied widely. Subsequently, capacity factors in the US have climbed markedly, so that the average is now slightly above 90%.

How should capacity factor risk impact the valuation of a prospective new build power plant? Few economic analyses address this question explicitly. The standard discounted cash flow model simply applies a single risk-adjusted discount rate to the aggregate cash flow line, discounting successive year's cash flows by the compounded discount rate. Although not widely appreciated, this simple model embodies a very restrictive implicit assumption about the dynamic structure of risk at the level of the aggregate cash flow: that is, the risk or variance of the cash flow grows linearly with time. This structure is consistent with the risk being well described as a geometric Brownian motion, but is not consistent with many other dynamic risk structures. Capacity factor risk is unlikely to be well described by a geometric Brownian motion. Uncertainty on the capacity factor parameter will almost certainly not grow linearly with time. But what is the dynamic structure of capacity factor risk? Answering this question is a prerequisite to turning to more advanced valuation techniques, such as a real options model or similar tools.[1]

In this paper we provide a fully specified model of the dynamic structure of capacity factor risk. We then fit the parameters of the model to the IAEA's PRIS dataset of historical capacity factors on reactors across the globe from 1969 to 2010 (i.e., before the Fukushima disaster).

We find that capacity factor risk is greatest in the first year of operation and quickly declines until it is approximately constant. Whether risk is constant or increasing in later years depends significantly on the probability of a premature permanent shutdown of the reactor. Because these should be rare events, the small historical sample may not provide a reliable estimate, and estimates can vary significantly depending upon how the data is used. Our base case is parameterized with a conservatively low probability of a premature permanent shutdown which yields the approximately constant variance after the initial years of a reactor's life. We show how the dynamic structure of risk may change as this estimate changes.

In the course of fitting our model, we also obtain a relatively low estimate for the mean capacity factor, approximately 73%. This is very low relative to the 85% or higher figures commonly employed in investor cash flow models. We examine various subsets

---

1 For example, Rothwell (2006) values a nuclear new build using the real option technique. However, he continues to rely upon the Brownian motion assumption. Another example is Samis (2009), who uses a mean reverting process to model the electricity price risk.

of the data to account for possible factors that could bias our numbers to a low level. These do argue for an upward adjustment in the expected level of the capacity factor through the life of the plant, but the adjustments are small and the final estimate remains well short of the 85% mark, unless the sample chosen is restricted to selected countries over select years.

There is a large literature analyzing the determinants of the capacity factor. Joskow and Rozanski (1979) estimate a significant learning curve for the operator, with the expected capacity factor increasing significantly in the first years of operation. They also document some learning by the manufacturer as successive plants of the same design are produced. They document some difference in the learning curve by reactor design, but essentially no difference across countries. Finally, they noted that the larger reactor designs had lower capacity factors. Easterling (1982) estimates that the learning effect on capacity factors is greatest during the first five years of operation. The variability of capacity factors is highest in the first year. He notes that different designs have different mean capacity factors, and that there are persistent differences in the individual unit capacity factors that could possibly represent any number of other factors. Krautmann and Solow (1988) find that the age of the unit, its vintage, the size of the unit, and the past year's capacity factor are all significant determinants of the expected capacity factor. Rothwell (1990) refines the observation of the capacity factor by organizing the data according to the frequency for refueling, which need not be annual, the frequency used in most analyses. He also decomposes the capacity factor into the service factor—i.e., whether the unit is available or has been taken down for refueling or for repair—and the capacity utilization when operating. Finally, he segments the dataset by manufacturer.

The results for age are very mixed across manufacturers, and so he argues it should not be used to estimate the expected capacity factor. Similarly, the results for size seem to relate to specific designs and not to size generally.[2] Krautmann and Solow (1992) show that improvements in the expected capacity factor with the age of the unit appear to have exhausted themselves in the period following the Three Mile Island accident, and that the units of at least one design were on the declining side of the age-performance curve. Lester and McCabe (1993) find a learning curve effect in the first three years of a units operation, and then document the differential learning curves for units operated at the same site, as well as the role of experience by design, by company and for the industry as a whole. Sturm (1993) identifies declining performance with age for countries in the former Soviet Union and Eastern Europe, especially attributable to the years immediately following the political transformations of the late 1980s and early 1990s. This is in contrast to the improving performance with age in the West at the same time, and even with identical reactor designs. Noting the significant improvements in the capacity factors among US nuclear power plants, Rothwell (2000) provides an updated estimate of the expected capacity factors by design type, manufacturer and size of the unit. Rothwell (2006) updates this for one cohort. Koomey and Hultman (2007) also note the significant improvement in the mean capacity factor at US units.

---

[2] There is related work on factors that one might expect to enter as a determinant of the capacity factor. For example, Roberts and Burwell (1981) estimate the learning curve in licensee events reports and how this is impacted by placing new reactors at the same site as existing reactors. A lower number of events may lead to an increased capacity factor, although the authors did not report on capacity factors. David Maude-Griffin and Rothwell (1996) document how the hazard rate for an unplanned outage declined after the Three-Mile-Island reactor incident and the ensuing regulatory policy changes. Sturm (1994) also evaluates the time between forced outages, and finds significant country differences. Within country no differences by design generation or date of construction are identifiable.

Our contribution to this literature is our focus on the variability in the capacity factor and the risk structure through time.

A portion of the previous literature touches on the variability in the capacity factor, including the random process of unplanned shutdowns and the decision to permanently shutdown a reactor. Rothwell (2007) incorporates a measure of the volatility in the capacity factor into his valuation model. It appears that volatility is estimated as if the factor were generated by a Brownian motion. Sturm (1995) estimates nuclear power production at a plant as a controlled stochastic process. The technology defines certain tradeoffs facing plant managers, and these managers make choices in operating the plant to optimize an objective function. This yields an estimated stochastic process for unplanned outages and plant capacity when operating. Given the complexity of the problem, the data used for estimating the model is chosen from a narrow time window likely to reflect a stable technology and objective function. Rothwell and Rust (1995) estimate a similar type of model in order to estimate the endogenous decision to permanently shutdown a plant. Rothwell (2000) also estimates the differential likelihood of different US plants being permanently shutdown as the regulatory environment shifts.

Our paper does not report the volatility or likelihood of a shutdown estimated from an optimization problem. We model the capacity factor risk structure as if the capacity factor were an exogenous variable.

2. A STOCHASTIC MODEL OF THE CAPACITY FACTOR

Denote a nuclear power plant's capacity factor in year t as F_t. Denote by T the number of years in the normal economic life of the plant—for example, the normal economic life may be 40 or 60 years. Then the profile of the capacity factor over the life of the plant, t=1,…T, is, F_1,…,F_T. We assume that in each year, the capacity factor can take on only the integer values from 0% to 100%. In addition, we assume that the plant may permanently shut-down, despite not having yet reached the end of its normal economic life, i.e., despite the fact that $t \leq T$. We call this a premature permanent shutdown. Once a plant is permanently shutdown, it cannot be restarted, so there is a difference between a capacity factor of 0% and the state of being permanently shutdown.

We model the evolution of the capacity factor over the life of the plant as a stochastic process. This allows us to reflect correlation between the capacity factors across years. For example, a plant currently operating at 50% capacity factor may be more likely to operate at 50% in the next year than is a plant currently operating at 95%. We initially assume that the probability distribution for the capacity factor at t is conditioned only on the capacity factor at t-1, and so is independent of the age of the plant. Obviously, one could make a case that the distribution might vary according to the reactor's age, among other factors, and we revisit this possibility later in the paper.

Define $\phi_{start,j}$ as the probability that in the year of start-up the capacity factor takes the value $j \in \{0\%, 1\%, \ldots, 100\%\}$. For any other year, t, the probability that a reactor with capacity factor i transitions to capacity factor j in year t+1, is denoted by $\phi_{i,j}$, $i \in \{0\%, 1\%, \ldots, 100\%\}$, $j \in \{0\%, 1\%, \ldots, 100\%\}$. These probabilities are all conditional on the reactor still operating in year t+1, i.e., it has not been permanently shutdown. Note that except for the start-up year, they are independent of the year t. Define Φ as the conditional transition matrix with 102×101 elements $\phi_{i,j}$, $i \in \{\text{“start”}\} \cup \{0\%, 1\%, \ldots, 100\%\}$, $j \in \{0\%, 1\%, \ldots, 100\%\}$.

Define θ_i as the probability that a reactor with a capacity factor i in year t the plant is permanently shutdown in year t+1. Define Θ as the 102×1 matrix of permanent shutdown probabilities, θ_i, $i \in \{\text{“start”}\} \cup \{0\%, 1\%, \ldots, 100\%\}$.

Define $\pi_{i,j}$ as the unconditional transition probability, with i being the capacity factor in year t and j being the value in year t+1, $i \in \{\text{“start”}\} \cup \{0\%, 1\%, \ldots, 100\%\}$, $j \in \{0\%, 1\%, \ldots, 100\%\} \cup \{\text{“shutdown”}\}$. We assume the probability $\pi_{i,j}$ is a mixture of two distributions: the probability of a permanent shutdown, and, given no permanent shutdown, the probability of transitioning from one integer capacity factor value to another:

$$\pi_{i,j} = \begin{cases} \varphi_{i,j}\left(1-\theta_i\right) & \textit{for } j \in \{0\%, 1\%, \ldots, 99\%, 100\} \\ \theta_i & \textit{for } j = \textit{shutdown} \end{cases}.$$

Define Π as the unconditional transition matrix with 102×102 elements $\pi_{i,j}$, $i \in \{\text{“start”}\} \cup \{0\%, 1\%, \ldots, 100\%\}$, $j \in \{0\%, 1\%, \ldots, 100\%\} \cup \{\text{“shutdown”}\}$.

This simple structure enables us to calculate a time profile of stochastic capacity factors for a new build nuclear power plant. Define $p_{t,j}$ as the unconditional probability that the capacity factor in year t equals j. Define P as the T×102 matrix with elements $p_{t,j}$, t=1,…T, $j \in \{0\%, 1\%, \ldots, 100\%\} \cup \{\text{“shutdown”}\}$. The first row of P is the first year's probability distribution, $p_{1,j}=\pi_{start,j}$. We can derive the successive rows by successive matrix multiplication using Π:

$$p_{t,*} = p_{t-1,*}\,\Pi,$$

where $p_{t,*}$ is the t^{th} row of P, with 1×102 elements, $p_{t\text{-}1,*}$ is the previous row of P, with 1×102 elements, and Π is the 102×102 transition matrix.

3. ESTIMATION

The IAEA's PRIS database reports a variety of data on individual reactors throughout the world, including annual performance data. Table 1 shows some summary information on the PRIS data. As of year-end 2010, the database included information on 542 reactors that had operated for some subset of years since 1969. Of these, 429 were in OECD countries, while 113 were in non-OECD countries. For calendar year 1969 the database includes information on only a single operating reactor. This number grows quickly to a maximum of 448 operating reactors in 2005. Obviously, early in the database the reactors included are young: the median age of operating reactors is less or equal to 5 years through 1978, growing to 10 years in 1990, and reaching 26 years in 2010.[3]

The database provides several alternative capacity factor measures as described in more detail in Appendix 1. In our analysis below we focus exclusively on the variable called "Load Factor" (LF), so for the remainder of this paper the reader should treat the term Load Factor as synonymous with capacity factor.[4] Table 2 shows how the median Load Factor reported in the PRIS database has evolved over time, growing from the 60% range in the early 1970s to approximately 85% in the 2000s. The standard deviation of

---

[3] Although the PRIS database of capacity factors is relatively comprehensive, it turns out that the capacity factors for a few reactors are missing. We did not investigate or try to resolve these few missing observations.

[4] Although the data is available on-line, the mode of access currently makes it inconvenient to acquire a complete overview of the data. Upon request, the IAEA provided us the data in a convenient spreadsheet form, and we have posted that on our website together with this paper so that others can easily access the same data. See: web.mit.edu/ceepr/www/publications/workingpapers.html

the annual Load Factors has not changed very much over time, fluctuating modestly around 22% throughout the life of the database.

Importantly, the database includes the time series of performance data on reactors that have since been permanently shutdown. Table 1 shows the number of reactors permanently shutdown each year, together with the cumulative number of permanent shutdowns. There are 99 reactors in the database that had been permanently shutdown as of 2010. The large majority of these shutdowns occurred because the reactor reached the end of its useful life, or became technologically outdated, or because economic factors no longer make it worth operating. A few of these shutdowns occur because of accidents or other operational problems. The database provides some information on these reasons, although it is useful to have more detail on each case.[5] We will return later to examine more carefully the issue of reactors that are both temporarily and permanently shutdown.

The PRIS database includes several different types of reactors. The vast majority—407 of the 542 reactors, or 75%—belong to either the boiling light water reactor (BWR) or to the pressurized light water reactor (PWR) categories that currently dominate the commercial reactor industry. The database also includes less popular commercial designs such as the 55 pressurized heavy water reactors (including the Canadian CANDUs), and designs no longer built for commercial purposes, such as the 42 gas cooled, graphite moderated reactors (widely used in the UK among other places) or the 21 light water cooled, graphite moderated reactors (which includes the shutdown

[5] Table 1 counts permanent shutdowns among those reactors reporting load factors in the PRIS dataset. Separately, the IAEA provides a list of 125 permanently shutdown reactors, with 7 shutdown prior to 1969 and 118 since. We have not investigated the discrepancy of 19 reactors shutdown since 1969 with no load factor data in the PRIS dataset.

Chernobyl reactors and cousins elsewhere in the territory of the former Soviet Union). Being comprehensive, the database also includes unusual and experimental designs, including 4 high temperature reactors, 4 heavy water moderated reactors, and 1 steam generating heavy water moderated, light water cooled reactor. There are 8 fast reactors, a very different type of reactor that has primarily been constructed on an experimental or a demonstration basis. A few of the reactors in the larger categories, too, were small experimental or demonstration reactors.

We limit ourselves to data on the broad classes of BWR, PWR and PHWR designs, and to exclude all reactors with capacity less than 300 MW since most of these are either experimental or demonstration projects and not commercial reactors. This leaves us with a total of 428 reactors.

We organize the sample data into a conditional transition matrix, Φ^{sample}, by populating the elements of the matrix with a simple count of the observed transitions. Reactor-by-reactor, we simply count the number of year-to-year transitions from capacity factor i to capacity factor j, and sum across all reactors. In the PRIS database, capacity factors are reported to the 12th decimal place. In doing our count, we round down to the nearest integer. Therefore, the row denoted by 90 percent includes all capacity factors from 90 percent up to, but strictly less than 91 percent. An exception to this rule applies for reactors operating above 100 percent capacity factor, which are classed in the 100 percent level regardless of the margin the actual power generation exceeds the reference power generation. The mass of observations is for Load Factors above 50%, and there are transition elements with no observations. Count values in each row are then normalized to a sum of one by dividing each row entry by the sum of the count values for the row.

Table 3 shows an extract of this sample conditional transition matrix. Figure 1 is a graphical display of the matrix.

Table 4 shows the conditional sample mean capacity factor in year *t*, given each capacity factor in year *t*-1, $\overline{\varphi}_i^{sample} = \sum_{j=0}^{100} j \ \varphi_{i,j}^{sample}$, $i \in \{0\%, 1\%, \ldots, 100\%\}$. These values are also plotted in Figure 2. Clearly the conditional expected capacity factor in year *t*+1is increasing as a function of the capacity factor in year *t*. Reactors performing at a high capacity factor tended to maintain a high capacity factor. Table 5 also shows the sample variance of the capacity factor in year *t*+1, given each capacity factor in year *t*, $\sum_{j=0}^{100} \left(j - \overline{\varphi}_i^{sample}\right)^2 \varphi_{i,j}^{sample}$, and these values are also plotted in Figure 3. The variance of the capacity factor in year *t* is a declining function of the capacity factor in year *t*-1. Reactors performing at a low capacity factor tended to exhibit more variable performance the following year.

We go from this sample matrix to the estimated matrix by making some regularity assumptions on the structure of the estimated matrix. In particular, we estimated the underlying distribution means and variances by regressing the log of the sample mean and the log of the sample variance onto the initial capacity factor. Since there are many more observations at higher capacity factors, we weight these regressions by the number of observations at each initial capacity factor. Table 5 reports the results of this OLS regression with robust standard errors. Table 4 shows the fitted moments at each capacity factor using the parameter estimates from the regression in Table 5. We then assume that

$\phi_{i,j}$ is a Beta-binomial distribution with n=100 and parameters $\alpha(F_i)$ and $\beta(F_i)$. We back out the parameters from the estimated mean and variance using the relations

$$\mu(F_i) = \alpha(F_i) / (\alpha(F_i) + \beta(F_i)), \text{ and}$$

$$\sigma^2(F_i) = \alpha(F_i)\beta(F_i) / \left((\alpha(F_i) + \beta(F_i))^2 (\alpha(F_i) + \beta(F_i) + 1) \right).$$

The resulting estimates for $\alpha(F_i)$ and $\beta(F_i)$ are also shown in Table 5. For the start-up year, we let the sample moments be our inputs to the estimation of the alpha and beta parameters. Figure 4 illustrates the results by displaying three probability distributions associated with three different initial capacity factors. Each distribution describes the probability of the capacity factor in year t+1 given its respective capacity factor in year t. The pattern described above—in which reactors already performing at a high capacity factor tend to maintain such performance, while reactors performing at lower capacity factors at any given year tend to exhibit more-variable performance the following year—is reflected in the resulting conditional implied Beta distributions.

Having estimated the conditional transition matrix, we now turn to estimating the probability of permanent shutdown, Θ. Not all permanent shutdowns convey the same information: a permanent shutdown precipitated by an accident is different from a permanent shutdown after 40 years of commercial life when license renewal would require major capital investments.[6] We also must be careful to identify reactors which, though still technically licensed to operate, have nevertheless been effectively shutdown.

[6] What we observe in the PRIS database is not a purely exogenous variable. It is, in part, an outcome of a valuation decision being made. This is most obvious in the case of permanent shutdowns. As we mentioned in the introduction, a few studies attempt to address this distinction explicitly, at least with respect to certain specific variables. These include Sturm (1995), Rothwell and Rust (1995) and Rothwell (2000).

Table 6a lists all reactors in our base case sample that are reported by the PRIS database to have been permanently shutdown prior to 2011. We sort this list into 2 mutually exclusive categories. One is involuntary shutdowns. This is the count that we use to construct our premature permanent shutdown probability. The second is voluntary shutdowns. These are excluded from the count that we use to construct our permanent shutdown probability. The sort is done as follows. All shutdowns that occur after the 35th year of operation are excluded from the "exogenous" shutdown category on the basis that the plant is approximately at the end of its originally intended useful life. We then reference the "reasons" for shutdown listed in the IAEA database. Categories 1-3 and 5-7 are counted as voluntary shutdowns and excluded from our count of premature permanent shutdowns. Categories 4 and 8-10 are counted as involuntary shutdowns and included in our count of premature permanent shutdowns. In some cases multiple reasons are given: whenever at least one reason falls in the involuntary category, the reactor is categorized as involuntarily shutdown and added to our premature permanent shutdown count. At the conclusion of this step we are left with 13 reactors in our base case sample that were involuntarily shutdown and that enter into our count as premature permanent shutdowns.

Table 6b lists all reactors in our base case sample that are reported by the PRIS database to have experienced an extended period of dormancy, i.e., 4 or more years with no commercial production. These are reactors that are shutdown for an extended period of time, but continue on the IAEA's list as still licensed for operation and show a zero Load Factor. In 11 cases identified in the table we treat these reactors as having been permanently shutdown at the start of the dormancy period. According to our algorithm stated above, these shutdowns are treated as voluntary and therefore do not add to the permanent shutdown count. However, this eliminates the successive zero Load Factor counts from affecting our estimation of the transition probability given a zero Load Factor. In four cases identified in the table, after substantive reinvestment and new construction, the reactor is re-started, and we treat this as an entirely new reactor, which impacts our estimate of the start-up probability.

This methodology is likely to underestimate the sample frequency of premature permanent shutdowns caused by exogenous factors, at least as a financial investor considering the value of constructing a new reactor is likely to view it. Several of the shutdowns that are categorized as voluntary could easily be categorized as involuntary, once again from the perspective of the financial investor: for example, the shutdown of the Browns Ferry reactors in the US, the shutdown of the Armenia reactor, and the shutdown of the Barsebäck reactor in Switzerland, to name a few. And some reactors that began construction but were never completed or that never generated power commercially—such as the Shoreham plant in the US—never make it into the dataset and so do not add to the count of permanent shutdowns.

Because even a small number of permanent shutdowns has a large impact on the unconditional expected capacity factor, and because of the subjective element involved in assessing the relevance of the small sample of permanent shutdowns for future operation, the correct estimation of the probability of a permanent shutdown going forward is likely a very contentious issue in valuation of a new nuclear power plant. The algorithm chosen here results in a much smaller count of prematurely permanently shutdown reactors than in the raw dataset. This has a major effect on the unconditional expected capacity factor and on the unconditional volatility of the capacity factor, as we shall see below. This emphasizes the necessity of applying careful judgment in estimating this probability using historical data.

Table 7 shows the sample distribution of permanent shutdowns, Θ^{sample}, determined by counting the number of premature permanent shutdowns for each given load factor range and then dividing by the total count of transitions for that particular load factor range. We then constructed a smoothed, fitted set of probabilities via heteroscedacity-robust ordinary least squares regression of natural logs of raw probability figures against load factor in year *t*. The exponential best-fit curve was then scaled so that the sum of all fitted values equaled the sum of the sample values.[7] Both the fitted and the scaled results are also shown in Table 7.

The estimated conditional transition matrix, Φ, and the estimated probability of a permanent shutdown, Θ, combine to form the estimated unconditional transition matrix, Π. With this we can calculate *P*, the matrix of estimated probability distributions for the capacity factor in each year of a reactor's life. Table 8 shows the unconditional mean and variance of the load factor in each year of operation from *P*. The table shows these calculated unconditionally and conditional on the reactor still being in operation, i.e., not permanently shutdown.

[7] The unconditional probability of a permanent shutdown is determined by the interaction between the conditional transition matrix which determines the probability of arriving at any load factor in year *t*, and this conditional probability of shutdown. Therefore, unfortunately, this scaling does not necessarily assure that the resulting unconditional probability of a shutdown matches the sample frequency. We have not estimated the discrepancy in our estimations.

We can see from Table 8 that the conditional variance is 9.6% in the first year and asymptotes quickly to 3.9%. The unconditional variance also is 9.6% in the first year.[8] It declines quickly in the next few years. Ultimately, due to the compounding probability of a permanent shutdown, the unconditional variance begins to gradually rise with the year of operation, although this ascent is negligible here given our construction of the probability of shutdown. This risk profile is the main result of this paper. It is graphed in Figure 5.

Table 8 also shows that for the raw sample, the conditional mean capacity factor is 54% in year 1. It quickly increases and asymptotes to 77%. The unconditional mean capacity factor is 54% in the first year after start-up. The unconditional mean capacity factor also rises gradually over the first few years of operation, reaching a peak at approximately 76%. However, due to the compounding probability of a permanent shutdown, the mean capacity factor falls again, if only trivially to 75% by year 60 of operation. The increasing mean of the conditional probability distribution in the first few years reflects the fact that the conditional transition probability at start-up has a relatively low mean, below the steady-state conditional distribution to which it must rise. This happens to produce the same empirical observation as one would get with an explicit learning curve.

4. FURTHER ANALYSIS

In this section we briefly summarize the impact of segmenting the data in selected ways. The full results for all of these variations are provided in Appendix 2.

---

[8] The mean and the variance of the first year of operation as shown in Table 7 should match the sample mean and variance in the year of start-up as shown in Table 4. The discrepancy between the entries in the two tables comes from our discretization of the range of load factors in the *P* matrix.

Age results

The model employed here assumes that the transition probability is completely determined by the current capacity factor. No other information determines the transition probability. One of the many alternative factors that could be relevant is the age of the reactor. As a first pass at this problem, we separately estimate the model for the first 5 years of reactor operation and for later years. Transitions from year 4 into year 5 are in the first category, and transitions from year 5 into year 6 are in the second category. Allowing the age of the reactor to determine its transition probability causes the mean capacity factor to peak at a higher level, approximately 3 percentage points higher, reflecting better performance of older reactors. Curiously, the variance in performance is greater among older reactors. This raises the level at which the unconditional variance in the capacity factor flattens out with reactor age, moving it from 3.9% to 4.7%.

Epoch results

We have already noted the obvious trend in the median capacity factor apparent in Table 2. This trend may reflect a number of different things, including changes in reactor design that make them more reliable and easier to maintain, as well as improved management practices. For example, in the United States, the number of days required to reload fuel fell from 104 in 1990 to 40 in 2010. This contributed significantly to raising capacity factors in the US.[9] Given changes such as this, to what extent is the historical data informative about future expectations for a new reactor's capacity factor? To take a first look at this issue, the base case dataset is divided into transitions occurring pre- and post-2000. For pre-2000 data, the mean capacity factor, conditional on operation,

---

[9] Davis and Wolfram (2011) analyze the role that deregulation and consolidation played in the changing performance of the US industry.

asymptotes to 72%, 5 percentage points below the asymptote for the base case. For post-2000 data, the mean capacity factor conditional on operation asymptotes just above 90%, a full 13 percentage points above the asymptote for the base case. However, post-2000 data is slower in adjusting to its asymptote, so this overstates the increase in the capacity factor in levelized terms. Using a 7% discount rate, in levelized terms the difference from the base case is approximately 6 percentage points, not 13. Therefore, in comparable terms the base case asymptote is a 77% mean capacity factor and the post-2000 data yields an 83% capacity factor.

Bloc results

As one can see in Table 2, the mean capacity factor of reactors operated in OECD countries is higher than the mean capacity factor of reactors operated in non-OECD countries. To explore the impact of the very different contexts of these two settings, we divided the dataset into two and estimated the transition matrix separately for each. Because the OECD reactors dominate the dataset, the results for the OECD only differ slightly from the results for the base case. For the non-OECD, the asymptote of the mean capacity factor conditional on operation is more than 4 percentage points below the base case. The major difference arises in the unconditional means and variances because of the different estimated probability of shutdown. Non-OECD reactors dominate the sample of permanent reactor shutdowns, and when this sample is used with a smaller overall number of reactor years it markedly raises the probability of shutdown. Therefore, the unconditional mean capacity factor drops after peaking in year 7. This emphasizes the difficulty inherent in reliably estimating the probability of permanent shutdown. This difficulty applies to the whole dataset, including OECD countries. The disaster at

Fukushima serves to reinforce this caution mightily, since it is not in our dataset, but including it will markedly alter the unconditional mean capacity factor in the OECD.

Country results

Obviously, finer breakdowns within the dataset lead to even sharper distinctions. For example, if we look exclusively at reactors in the US we see an even more pronounced change between the pre- and post-2000 periods. The asymptote of the conditional mean capacity factor in the US is 71% pre-2000 and 91% post-2000. This change is at least in part due to major institutional changes in the US, and the latter figure is employed to justify forecasts of capacity factor of 90% or more for new builds in the US. However, one must be cautious about relying on the limited experience in one country at one time to set the forecast going forward. Elsewhere, change has been in the wrong direction. If we look exclusively at reactors in Japan, we find that the asymptote of the conditional mean capacity factor is 72% pre-2000 and only 62% post-2000. Recall that this poor performance in Japan precedes Fukushima. For US investors to use the 91% figure requires confidence that the institutional improvements in the US are irreversible and that new problems like those that plagued Japan could not arise in the US.

The segmentations performed above are not statistically independent of one another. For example, non-OECD reactor year observations are more heavily concentrated in the post-2000 data set. The post-2000 data set contains a different profile of reactor ages as compared to the pre-2000 data set. We have not attempted formal statistical tests of the differences identified above.

5. CONCLUSIONS

We developed a fully specified model of the dynamic structure of capacity factor risk. It incorporates the risk that the capacity factor may vary widely from year-to-year, and also the risk that the reactor may be permanently shutdown prior to its anticipated useful life. We then fit the parameters of the model to the IAEA's PRIS dataset of historical capacity factors on reactors across the globe.

Our main result is determining how capacity factor risk evolves through the life of a reactor, from the high starting level in the first year of operation, declining quickly over the next couple of years, after which it is approximately constant or gradually increasing. Whether risk is constant or increasing in later years depends significantly on the probability of an early, permanent shutdown of the reactor. Our base case is parameterized with a conservatively low probability of a permanent shutdown which yields approximately constant variance after the first few years.

Although our original objective was to understand the dynamic structure of capacity factor risk, in estimating our model we also found interesting results about the expected *level* of the capacity factor. Our model, combined with the global historical dataset, yields relatively low estimates for the expected *level* of the capacity factor through the life of the plant. Our base case estimate is an asymptote of approximately 77%. If we construct our estimate using historical data only for reactors installed in OECD countries, the estimate improves by approximately 1 percentage point. If we construct our estimate using historical data only for reactor performance since the year 2000, the estimate improves by approximately 6 percentage points. If we construct our estimate recognizing the different performance characteristics of young and old reactors, the estimated mean capacity factor is *reduced* in the first few years of operation, and increased in the later years. In this preliminary analysis, we did not attempt to construct an estimate combining each of these effects. But it is difficult to see from this first pass through the data how that would likely yield a result close to the 90% figures that are commonly used in advocating construction of new nuclear power plants.

Justification for such a high estimated mean capacity factor appears to require focusing exclusively on a much smaller subset of the data—e.g. only at the performance of mature plants in the United States since the year 2000—and simultaneously ignoring all of the other available data and experience. Certainly there may be a good reason for focusing on a small subset of the data and ignoring the other data. It is equally wrong to naively treat all datapoints as equally informative as it is to naively focus on only some of the datapoints and ignore the others. But we have not seen a careful justification for high estimates of the mean capacity factor that seriously confront the potential information available in the full data set.

We should reiterate here that we have been very conservative in calculating our estimate of the probability of a permanent shutdown. Our estimates using the raw data set show that a higher probability of a permanent shutdown could be easily rationalized using the historical experience. This parameter has a very strong influence on the unconditional mean capacity factor. Here again, judgment in exploiting the historical data is key. The disaster at Fukushima only reinforces that conclusion. We obtain our low estimate of the unconditional mean capacity factor despite being very conservative in estimating the probability of a permanent shutdown.

APPENDIX 1: ALTERNATIVE DEFINITIONS OF CAPACITY FACTOR

PRIS reports a variety of data on a reactor's operating performance, including the portion of time the reactor was on-line, the total energy generated, the energy lost due to planned outages, the energy lost due to unplanned outages and the energy lost due to external factors. PRIS also reports a reference level of energy generation, which is a measure of the nameplate capacity of the unit. These variables can be combined to calculate a number of different versions of a capacity factor. Discrepancies between the different versions tend to occur because they each reflect differently events in which the plant's potential generating capacity differs from its reference power rating due to factors outside the control of the plant operator. These factors include but are not limited to ambient temperature, which affects the plant's thermal efficiency, and periods of low electricity demand that do not result in complete utilization of a plant's electricity output. Higher generating potential arises during periods of colder temperatures relative to that of the plant's nameplate capacity, which increases the plant's heat sink capacity and in turn its power output. Therefore output may be greater than capacity. Examples of this are widespread among units reporting high capacity factors. One version of a capacity factor will reflect this, recording a capacity factor above 100%, while another version will adjust the baseline capacity to reflect the higher potential and record a capacity factor of 100%. Conversely, in a country like France where nuclear capacity exceeds base-load demand, inevitably some units are forced to follow load and cut generation below capacity although the plant is fully available. One version of a capacity factor will reflect this lower generation, while another version will adjust the baseline capacity to reflect the external constraint. In France in 2008, where nuclear power supplies over three-quarters of electricity output, the average capacity factor as measured by one version, the Load Factor, was a full two percentage points below the average capacity factor as measured by another version, the Energy Availability Factor — 75.9 percent versus 77.9 percent respectively.

To formalize this discussion, we provide the definitions of various elements in the calculation of capacity factors, and the formulas for different versions of capacity factors. These are the definitions as provided by the IAEA's PRIS dataset:

- T – Reference period – time from beginning of period, first electrical production (for units in power ascension), or start of commercial operation (for units in commercial operation), whichever comes last, to the end of the period or final shutdown, whichever comes first
- t – On-line hours – hours of operation (breakers closed to the station bus) during the reference period
- OF – Operating factor (%) = t/T×100
- RUP – Reference unit power (MW) – Maximum electrical power output maintained during prolonged operation at reference ambient conditions,
- REG – Reference energy generation (MWh) = RUP×T
- EG – Energy generated – net electric energy output after subtracting station load (electric energy drawn by the power station's components)
- LF – Load factor (%) = EG/REG×100
- PEL – Planned energy loss – energy not produced during the reference period due to planned outages (foreseen at least four months in advance) during refueling and other operations and maintenance activities
- PUF – Planned Unavailability Factor = PEL/REG
- UEL – Unplanned energy loss – energy not produced during the reference period due to unplanned outages (foreseen less than four months in advance) internal to the plant
- UUF – Unplanned Unavailability Factor = UEL/REG
- UCF – Unit capability factor (%) = (REG – PEL – UEL)/REG×100
- XEL – External energy loss – any energy loss due to causes external to the plant
- XUF – External Unavailability Factor = XEL/REG

- EAF – Energy availability factor (%) = (REG – PEL – UEL – XEL)/REG×100

To illustrate how the different versions of capacity factors reflect the specific situation of different units, Table A1 shows the data for four different reactors as reported in 2007. Column E shows the Genkai 4 Unit in Japan. It operated 100% of the time, so that its Operating Factor was 100%. However, its Load Factor was 101.5%. This is because the Energy Generated was more than its Reference Energy Generation, i.e. the ambient conditions in that year produced an actual capacity greater than the nameplate or reference capacity. Its Energy Availability Factor was 100%. This demonstrates the difference between the LF and the EAF. The LF reflects actual energy produced as against a reference or nameplate capacity, although the actual capacity may be higher or lower than the reference. In contrast, the EAF is normalized by whatever is the actual capacity of production. Therefore the EAF cannot be greater than 100%. Column F shows the Sequoyah 1 Unit in the United States. This unit operated 87.5% of the time, with 12.5% of the time down for planned outages. When it was operating, it must have been operating at full capacity since the EAF equals the OF. The LF is lower than the EAF, which must be because actual capacity across the hours of planned operation was less than the reference capacity. Column D shows the Wolsong 4 Unit in Korea. This unit operated 93.1% of the time. However, the EAF is only at 92.8%, so during some portion of the time it was operating it must have done so at slightly less than full capacity. Most of the time it was not operating was for planned outages, although a small portion was for unplanned outages. Column C shows the Cattenom 1 Unit in France. In addition to the planned and unplanned outages, there is a portion of its generation capacity that is unutilized, 1.5%, because of external factors. This is likely due to the need in France to operate some units in a load following mode, i.e. to not take the full capacity of the unit even when it is made available to the system. Therefore, the UCF is higher than the EAF.

APPENDIX 2: RESULTS FOR ALTERNATIVE SEGMENTATIONS OF THE DATA

Tables A2 through A26 present the estimation results for the data segmented by age of reactor, by epoch (pre- and post-2000), by OECD and non-OECD and the US and Japan results.

REFERENCES

David, Paul A, Roland Maude-Griffin, and Geoffrey Rothwell, 1996, Learning by Accident? Reductions in the Risk of Unplanned Outages in U.S. Nuclear Power Plants After Three Mile Island, Journal of Risk and Uncertainty, 13, 175-198.

Davis, Lucas and Catherine Wolfram, 2011, Deregulation, Consolidation, and Efficiency: Evidence from U.S. Nuclear Power, Energy Institute at Haas Working Paper 217.

Easterling, Robert G., 1982, Statistical Analysis of U.S. Power Plant Capacity Factors through 1979, Energy, 7.3, 253-258.

Hultman, Nathan E., Jonathan G. Koomey, and Daniel M. Kammen, 1 April 2007, What History Can Teach Us about the Future Costs of U.S. Nuclear Power, Environmental Science and Technology, 2088-2093.

Joskow, Paul L. and George A. Rozanski, 1979, The Effects of Learning by Doing on Nuclear Plant Operating Reliability, The Review of Economics and Statistics, 61.2, 161-168.

Komanoff, Charles, 1981, Power Plant Cost Escalation: Nuclear and Coal Capital Costs, Regulations, and Economics, New York: Van Nostrand Reinhold Company.

Koomey, Jonathan and Nathan E. Hultman, 2007, A reactor-level analysis of busbar costs for US nuclear plants, 1970-2005, Energy Policy, 35, 5630-5642.

Krautmann, Anthony C. and John L. Solow, 1988, Economies of Scale in Nuclear Power Generation, Southern Economic Journal, 55.1, 70-85.

Lester, Richard K. and Mark J. McCabe, 1993, The Effect of Industrial Structure on Learning by Doing in Nuclear Power Plant Operation, The RAND Journal of Economics, 24.3, 418-438.

Rothwell, Geoffrey, 1990, Utilization and Service: Decomposing Nuclear Reactor Capacity Factors, Resources and Energy, 12, 215-229.

---, 1996, Organizational Structure and Expected Output at Nuclear Power Plants, The Review of Economics and Statistics, 78.3, 482-488.

---, 2006. “A Real Options Approach to Evaluating New Nuclear Power Plants,” The Energy Journal 27, 1.

Rothwell, Geoffrey and John Rust, 1995, A dynamic programming model of US nuclear power plant operations, University of Wisconsin Department of Economics.

---, 1995, Optimal Response to a Shift in Regulatory Regimes, Journal of Applied Econometrics, 10. S75-S118.

---, 1997, On the Optimal Lifetime of Nuclear Power Plants, Journal of Business and Economic Statistics, 15.2, 195-208.

Samis, Michael, 2009, Using Dynamic Discounted Cash Flow and Real Option Simulation to Analyze a Financing Proposal for a Nuclear Power Plant, Ernst & Young presentation.

Sturm, Roland, 1993, Nuclear power in Eastern Europe: Learning or forgetting curves?, Energy Economics, 15.3, 183-189.

---, 1994, Proportional hazard regression models for point processes: An analysis of nuclear power plant operations in Europe, Journal of Applied Statistics, 21.6, 533-540.

---, 1995, Why does nuclear power performance differ across Europe?, European Economic Review, 39.6, 1197-1214.

Figure 1
Sample Conditional Transition Matrix

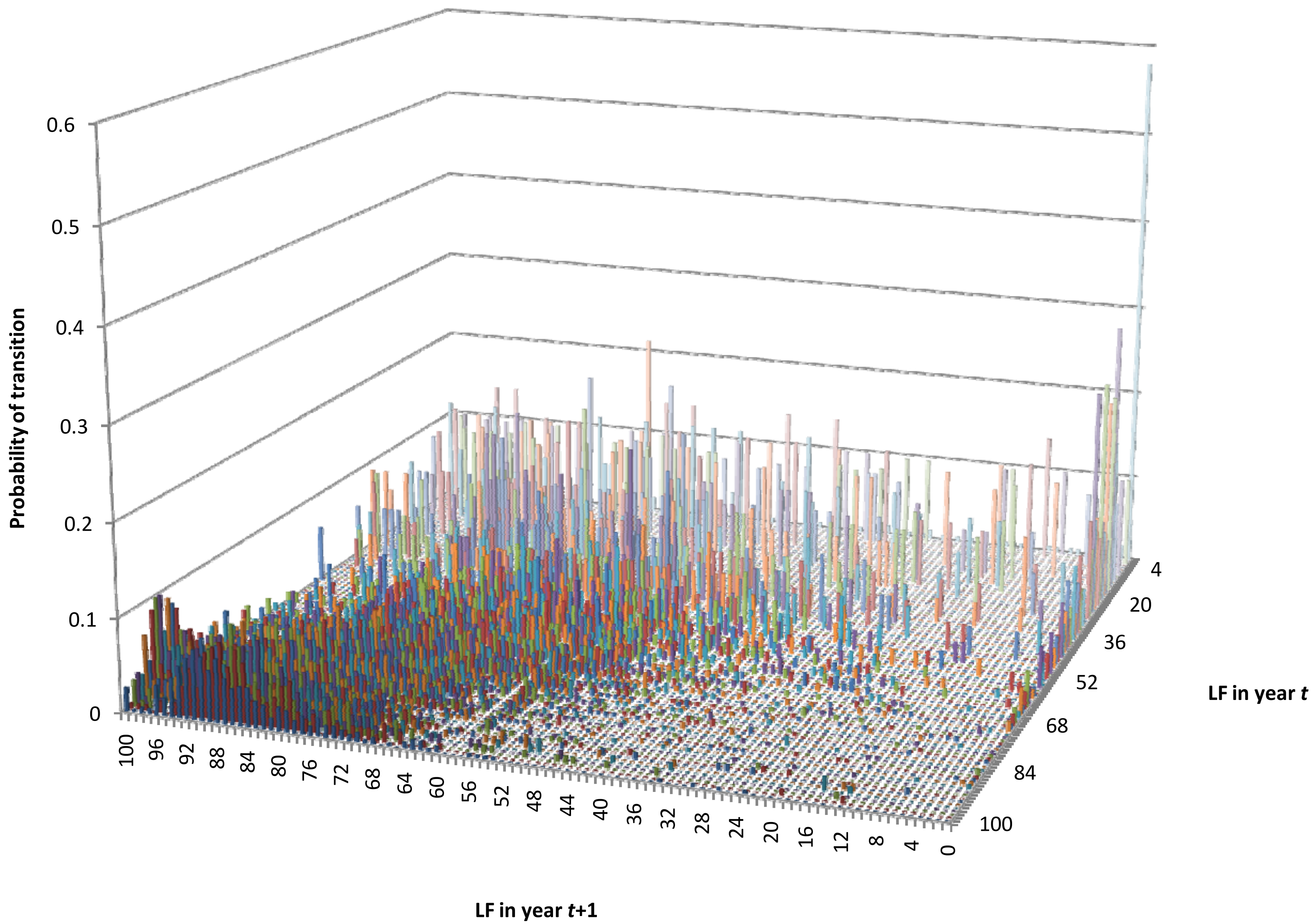


Figure 2
Sample and Fitted Mean of the Conditional Transition Probabilities, Ψ

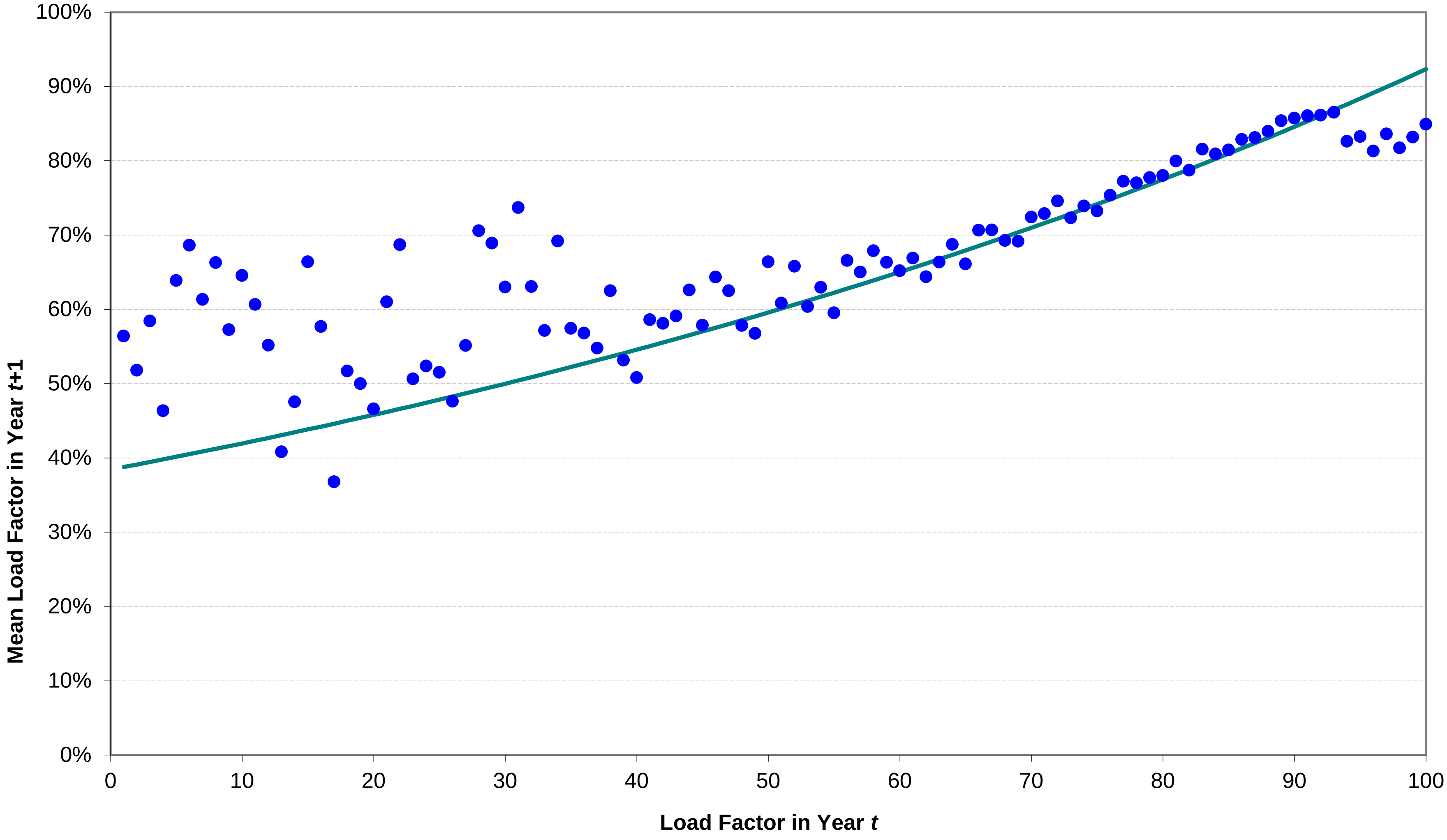


Figure 3
Sample and Fitted Variance of the Conditional Transition Probabilities, Ψ

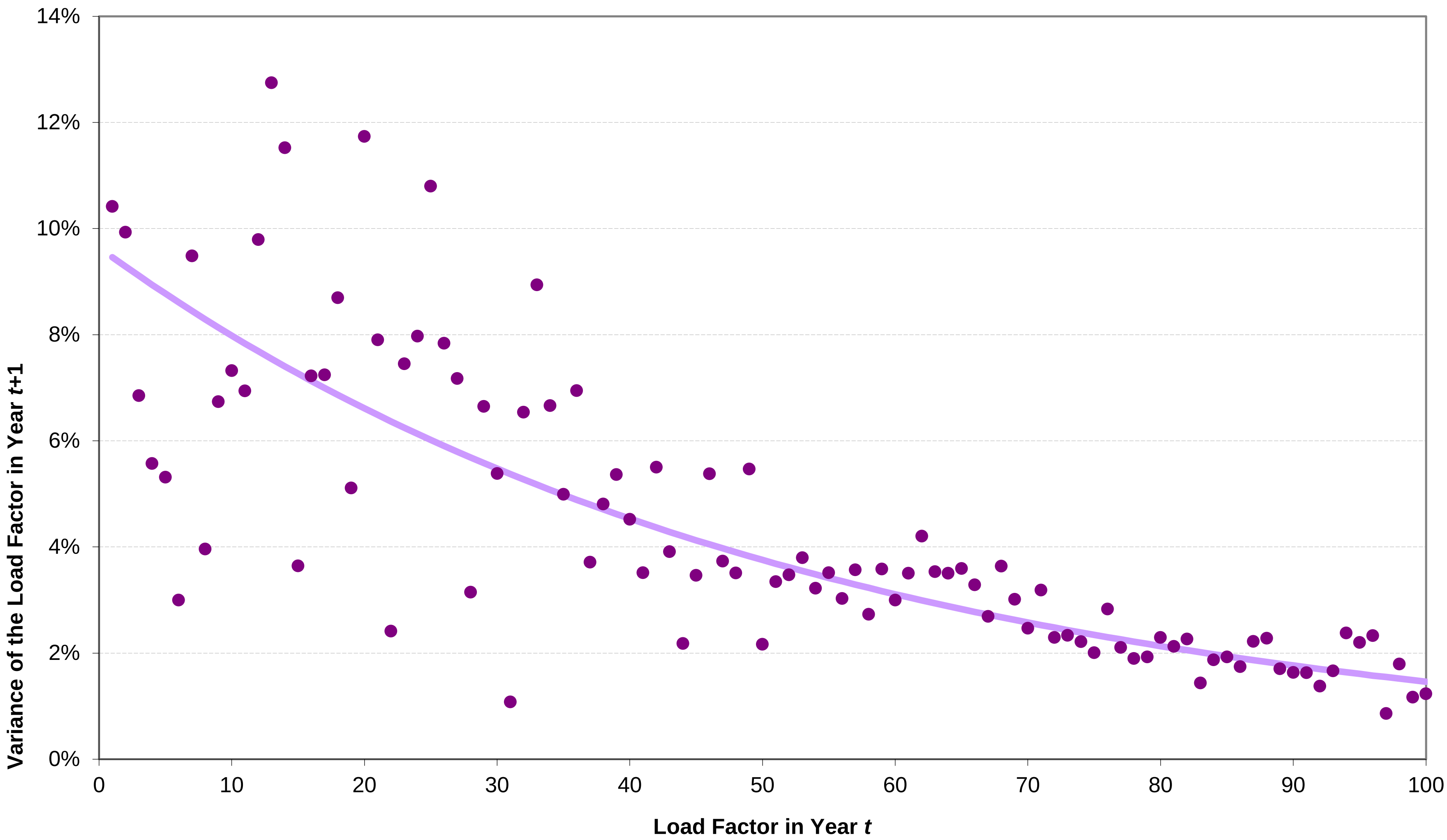
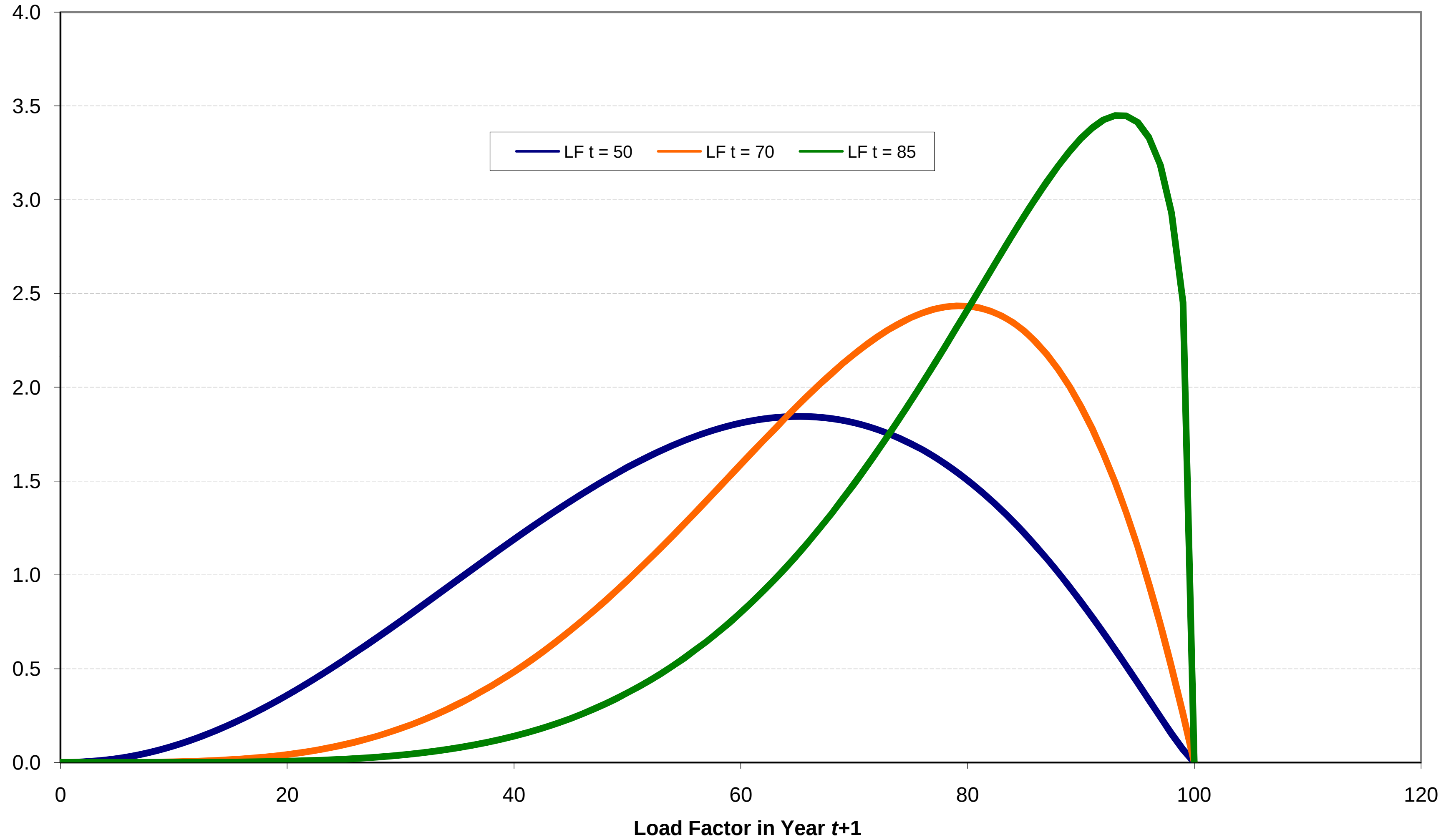


Figure 4: Implied Beta Probability Density Function over Load Factor in Year *t*+1, Conditional on Load Factor in Year *t*



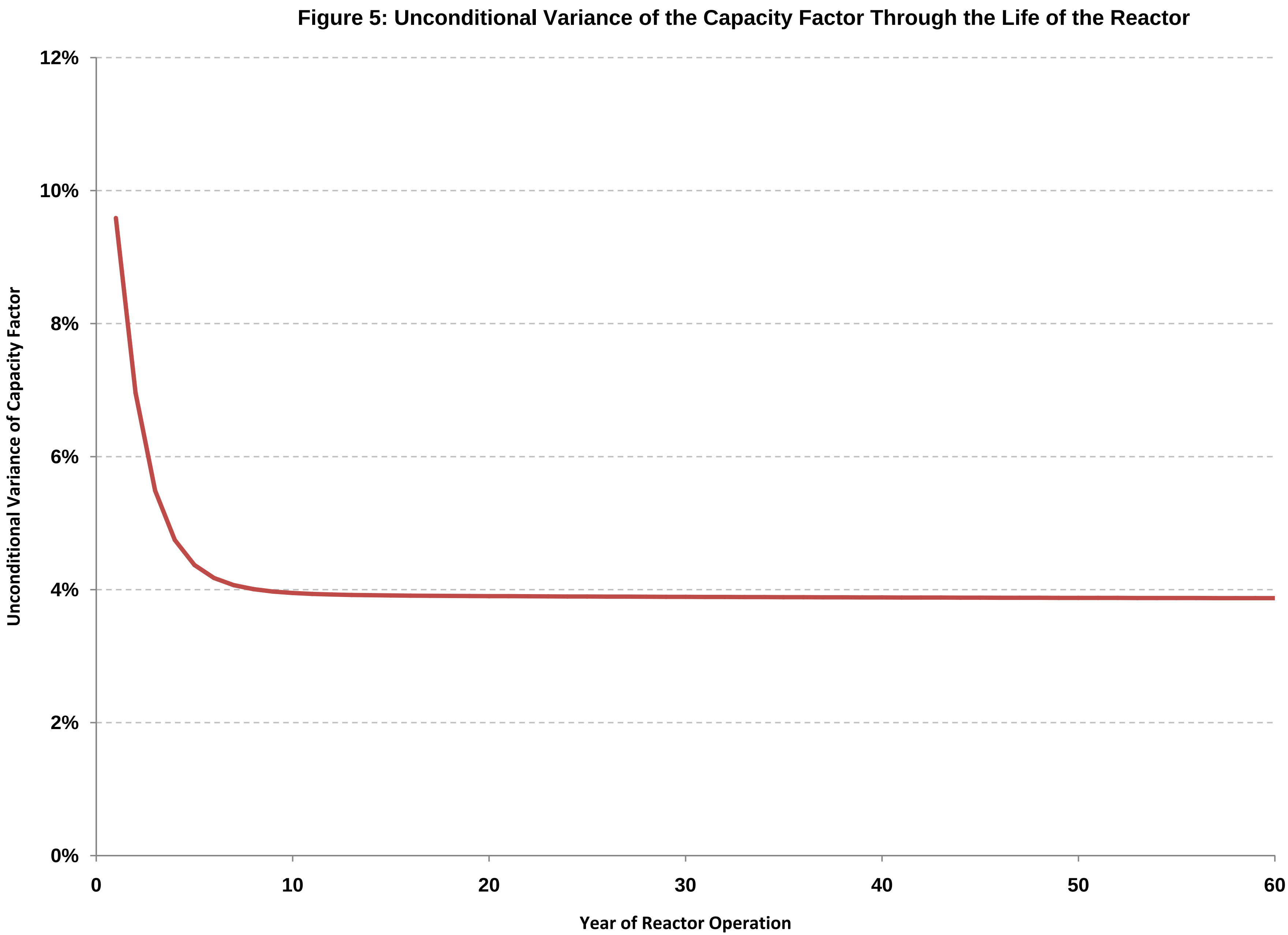


Figure 5: Unconditional Variance of the Capacity Factor Through the Life of the Reactor
12%
10%
8%
6%
4%
2%
0%
Unconditional Variance of Capacity Factor
0
10
20
30
40
50
60
Year of Reactor Operation

Table 1: Summary Annual Reactor Statistics for the IAEA's PRIS Database

Year	Number of Operating Reactors			Median Years of Operation			Permanent Shutdowns	
	All	OECD	non-OECD	All	OECD	non-OECD	Annual	Cum.
1969	1	1	0	1	1			
1970	29	29	0	1	1		0	0
1971	66	64	2	1	1	1	2	2
1972	84	79	5	2	2	1	1	3
1973	102	94	8	3	3	2	0	3
1974	127	115	12	3	4	2	4	7
1975	141	125	16	4	4	2.5	0	7
1976	157	139	18	5	5	3	2	9
1977	171	152	19	5	5	4	5	14
1978	183	164	19	5	6	5	2	16
1979	194	173	21	6	6	6	2	18
1980	209	186	23	7	7	7	1	19
1981	230	201	29	7	8	7	0	19
1982	249	214	35	8	8	7	0	19
1983	266	229	37	8	8.5	7	1	20
1984	300	258	42	8	8	5.5	3	23
1985	326	277	49	8	8	5	3	26
1986	347	296	51	8	9	6	2	28
1987	376	313	63	8	9	6	4	32
1988	391	327	64	9	9	7	3	35
1989	407	335	72	9	10	7.5	12	47
1990	406	335	71	10	10	8.5	3	50
1991	408	336	72	11	11	9	6	56
1992	407	334	73	11	12	10	3	59
1993	414	339	75	12	13	10	0	59
1994	418	340	78	13	13.5	11	4	63
1995	423	343	80	14	14	12	2	65
1996	428	347	81	14	15	13	6	71
1997	425	345	80	15	15	14	4	75
1998	424	344	80	16	16	15	2	77
1999	424	345	79	17	17	16	1	78
2000	432	347	85	18	18	16	1	79
2001	432	348	84	19	19	17	0	79
2002	438	351	87	19	20	18	2	81
2003	439	352	87	20	21	19	2	83
2004	444	352	92	21	22	19	1	84
2005	448	356	92	22	23	19.5	2	86
2006	448	354	94	23	24	20	8	94
2007	443	348	95	24	25	21	0	94
2008	443	348	95	25	26	22	1	95
2009	441	345	96	25	26	22	3	98
2010	444	344	100	26	27	23	1	99

Table 2: Summary Annual Load Factor Statistics for the IAEA's PRIS Database

Year	Median Load Factor			Standard Deviation of Load Factor		
	All	OECD	non-OECD	All	OECD	non-OECD
1969	5.8	5.8				
1970	66.4	66.4		21.3	21.3	
1971	66.0	66.4	1.7	25.2	23.2	0.6
1972	61.8	63.7	35.4	21.7	20.7	23.0
1973	61.0	61.9	53.3	24.5	24.7	23.0
1974	62.1	62.5	58.1	24.6	25.1	19.5
1975	66.0	69.3	49.4	24.2	24.6	18.3
1976	64.5	65.6	62.4	22.4	22.8	19.1
1977	67.9	68.9	63.1	22.0	22.5	17.2
1978	69.3	69.4	69.2	23.1	23.4	21.0
1979	64.9	63.4	73.2	22.3	22.3	22.1
1980	67.3	66.3	78.2	23.0	22.7	25.6
1981	67.9	67.4	75.7	23.1	22.8	25.5
1982	68.0	67.0	73.0	24.7	24.3	27.5
1983	69.9	69.4	76.9	23.3	23.3	23.8
1984	74.0	73.0	79.3	23.7	24.0	21.8
1985	75.2	75.2	77.3	21.1	21.2	20.7
1986	73.5	73.7	73.0	23.0	23.2	21.6
1987	73.0	72.9	73.6	22.5	22.2	23.9
1988	72.0	71.3	74.6	20.4	20.7	18.5
1989	72.8	72.8	73.2	21.5	21.4	21.9
1990	72.6	73.0	69.8	20.3	19.8	22.3
1991	74.7	75.9	64.3	20.1	19.9	19.0
1992	74.2	75.2	69.2	20.8	20.0	22.8
1993	75.0	77.2	63.4	21.5	20.5	22.1
1994	76.4	78.9	56.1	22.5	20.3	23.6
1995	77.9	79.6	60.5	21.4	18.9	23.0
1996	78.2	80.1	64.5	21.0	19.3	23.2
1997	78.4	80.9	67.4	22.6	22.3	21.5
1998	80.6	82.7	64.1	22.2	21.8	18.8
1999	82.4	84.8	66.4	19.7	18.5	19.5
2000	82.7	84.8	72.0	20.0	19.9	17.7
2001	83.8	85.7	73.7	19.2	19.0	17.2
2002	85.4	87.3	76.2	20.4	19.7	20.8
2003	83.5	85.1	79.3	21.8	22.3	19.0
2004	84.4	86.0	80.2	19.0	16.9	23.8
2005	84.1	85.8	76.7	18.6	17.3	21.0
2006	85.1	86.9	76.3	19.0	17.2	22.5
2007	84.4	85.4	79.7	20.9	20.2	22.1
2008	84.5	85.8	79.4	23.6	23.2	24.2
2009	83.6	84.6	78.2	23.8	23.3	24.7
2010	84.8	85.7	79.3	22.1	22.3	21.3

Table 3: Extract of the Sample Conditional Transition Matrix, Ψ^{sample}

Load Factor in year t	Load Factor in year t+1: 100	99	98	97	96	95	94	93	92	91	90
100	2.9	0.3	0.6	0.6	3.2	1.9	4.2	5.4	6.4	7.3	7.0
99	0.6	0.6	0.6		1.3		1.3	3.1	5.0	3.1	6.9
98	2.7	0.7	2.1		0.7	1.4	1.4	3.4	3.4	2.7	7.5
97	3.3	0.8		0.8		0.8		5.7	6.5	4.1	6.5
96	2.7	0.7	1.3	0.7	0.7	6.0	2.0	2.7	3.3	6.0	4.7
95	6.2	1.9	0.6	1.9	2.5	1.9	6.2	4.9	3.7	3.1	4.3
94	3.3	1.7	1.7	0.6	2.2	4.4	3.3	6.1	4.4	5.5	2.8
93	8.7	2.9	2.4	1.9	3.4	6.8	6.3	3.9	3.9	5.8	3.4
92	9.0	1.6	1.2	2.9	1.6	3.3	4.9	4.9	5.7	4.5	7.8
91	9.5	3.6	2.9	2.2	1.5	2.9	2.2	3.6	6.2	4.7	4.7
90	5.5	3.8	2.0	1.7	2.0	2.7	2.0	3.1	4.4	7.5	4.8
89	8.0	2.3	2.0	3.0	3.0	1.0	1.7	2.7	3.7	3.3	6.6
88	6.8	2.4	1.8	2.1	2.7	2.1	2.4	3.6	2.1	5.0	3.0
87	6.6	2.2	4.1	1.9	1.3	1.3	1.3	2.5	2.5	3.8	5.0
86	4.4	2.8	2.8	0.6	1.6	1.9	1.9	0.9	0.9	3.1	2.5
85	3.8	2.4	1.8	1.2	0.3	1.8	1.8	2.7	2.7	2.4	5.0
84	3.2	1.6	2.1	1.1	1.1	1.9	1.1	1.3	1.3	2.4	3.2
83	2.6	1.4	2.3	1.7	2.6	1.7	1.4	2.6	2.6	1.7	1.4
82	2.1	1.8	1.8	0.9	1.2	0.3	2.1	3.1	1.8	1.5	2.5
81	2.7	1.8	0.3	1.8	2.4	1.5	1.2	1.8	2.4	2.1	1.5
80	1.2	2.4	1.2	1.8	0.9	1.5	1.5	1.5	4.2	4.2	1.8
79	2.2	2.2	0.6	0.6	1.6	0.6	0.3	2.5	0.6	1.9	1.2
78	2.6	1.0	2.9	0.3	1.6	1.0	1.0	0.7	1.0	1.0	2.0
77	2.8	1.4	1.4	1.4	1.4	1.4	1.7	0.3	1.7	1.7	0.3
76	1.4	3.7	1.4	0.3	1.0	0.3	1.7	1.0	1.0	1.7	1.0
75	0.3	0.9	1.2	0.9	0.6	0.3	0.6	1.2	0.6	0.9	1.9
74	1.8	1.4	1.1	0.4	1.4			0.4	2.1	2.1	1.4
73	0.4	1.1		1.8		0.7	1.1	0.7	0.7	0.7	1.8
72	1.2	1.2		1.6	1.2	1.6	1.9	0.8	0.8	1.6	0.8
71	0.9	1.8	1.3	0.9	1.3	1.3	0.4	1.3	2.2	3.1	0.9
70	0.4	0.4		0.4	0.8	1.6	2.0	0.4	1.2	0.8	2.0
69	2.0	1.0		2.0	0.5		1.5		0.5	1.5	0.5
68	2.4	0.9	0.5	0.9	1.4	0.5	0.9	0.5	0.5	1.4	0.9
67	0.5		1.5	1.5	1.0	1.5	0.5	1.5	1.5	2.0	1.5
66	0.5	0.5	0.5	0.5	2.2	2.7	0.5	1.6	1.1	1.1	0.5
65		0.6		0.6	1.3	0.6	1.3		0.6	1.3	1.3
64	1.2	0.6	0.6	1.2	1.2	0.6	1.2	0.6	1.8	0.6	0.6
63			0.7				1.5		1.5	0.7	1.5
62	1.5				0.8		0.8		0.8	0.8	1.5
61				2.2		1.5	0.7	1.5	0.7	0.7	
60	0.7	0.7				0.7				1.4	

Table 4: Parameters of the Conditional Transition Probability, Φ, Base Case

Load Factor in Year t	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	85%	1.2%	92%	1.5%	3.55	0.30
99	83%	1.2%	92%	1.5%	3.85	0.36
98	82%	1.8%	91%	1.5%	4.12	0.42
97	84%	0.9%	90%	1.5%	4.37	0.49
96	81%	2.3%	89%	1.6%	4.58	0.56
95	83%	2.2%	88%	1.6%	4.77	0.63
94	83%	2.4%	88%	1.6%	4.94	0.70
93	87%	1.7%	87%	1.7%	5.08	0.77
92	86%	1.4%	86%	1.7%	5.21	0.84
91	86%	1.6%	85%	1.7%	5.32	0.91
90	86%	1.6%	85%	1.8%	5.40	0.99
89	85%	1.7%	84%	1.8%	5.48	1.06
88	84%	2.3%	83%	1.8%	5.53	1.12
87	83%	2.2%	82%	1.9%	5.58	1.19
86	83%	1.7%	82%	1.9%	5.61	1.26
85	81%	1.9%	81%	1.9%	5.63	1.32
84	81%	1.9%	80%	2.0%	5.63	1.39
83	82%	1.4%	80%	2.0%	5.63	1.45
82	79%	2.3%	79%	2.1%	5.62	1.51
81	80%	2.1%	78%	2.1%	5.60	1.56
80	78%	2.3%	77%	2.1%	5.57	1.62
79	78%	1.9%	77%	2.2%	5.53	1.67
78	77%	1.9%	76%	2.2%	5.49	1.72
77	77%	2.1%	75%	2.3%	5.44	1.77
76	75%	2.8%	75%	2.3%	5.38	1.81
75	73%	2.0%	74%	2.3%	5.33	1.86
74	74%	2.2%	74%	2.4%	5.26	1.90
73	72%	2.3%	73%	2.4%	5.19	1.93
72	75%	2.3%	72%	2.5%	5.12	1.97
71	73%	3.2%	72%	2.5%	5.05	2.00
70	72%	2.5%	71%	2.6%	4.97	2.03
69	69%	3.0%	70%	2.6%	4.89	2.06
68	69%	3.6%	70%	2.7%	4.81	2.09
67	71%	2.7%	69%	2.7%	4.72	2.11
66	71%	3.3%	69%	2.8%	4.64	2.13
65	66%	3.6%	68%	2.8%	4.55	2.15
64	69%	3.5%	67%	2.9%	4.46	2.17
63	66%	3.5%	67%	2.9%	4.38	2.18
62	64%	4.2%	66%	3.0%	4.29	2.19
61	67%	3.5%	66%	3.1%	4.20	2.20

Table 4: Parameters of the Conditional Transition Probability, Φ, Base Case

Load Factor in Year t	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
60	65%	3.0%	65%	3.1%	4.11	2.21
59	66%	3.6%	64%	3.2%	4.02	2.22
58	68%	2.7%	64%	3.2%	3.93	2.22
57	65%	3.6%	63%	3.3%	3.84	2.22
56	67%	3.0%	63%	3.4%	3.75	2.22
55	60%	3.5%	62%	3.4%	3.66	2.22
54	63%	3.2%	62%	3.5%	3.57	2.22
53	60%	3.8%	61%	3.5%	3.48	2.21
52	66%	3.5%	61%	3.6%	3.40	2.21
51	61%	3.3%	60%	3.7%	3.31	2.20
50	66%	2.2%	60%	3.8%	3.23	2.19
49	57%	5.5%	59%	3.8%	3.14	2.18
48	58%	3.5%	59%	3.9%	3.06	2.17
47	63%	3.7%	58%	4.0%	2.98	2.15
46	64%	5.4%	58%	4.0%	2.90	2.14
45	58%	3.5%	57%	4.1%	2.82	2.12
44	63%	2.2%	57%	4.2%	2.74	2.11
43	59%	3.9%	56%	4.3%	2.66	2.09
42	58%	5.5%	56%	4.4%	2.59	2.07
41	59%	3.5%	55%	4.4%	2.51	2.05
40	51%	4.5%	55%	4.5%	2.44	2.03
39	53%	5.4%	54%	4.6%	2.37	2.01
38	63%	4.8%	54%	4.7%	2.30	1.99
37	55%	3.7%	53%	4.8%	2.23	1.96
36	57%	6.9%	53%	4.9%	2.16	1.94
35	57%	5.0%	52%	5.0%	2.09	1.92
34	69%	6.7%	52%	5.1%	2.03	1.89
33	57%	8.9%	51%	5.2%	1.97	1.86
32	63%	6.5%	51%	5.3%	1.90	1.84
31	74%	1.1%	50%	5.4%	1.84	1.81
30	63%	5.4%	50%	5.5%	1.78	1.78
29	69%	6.6%	50%	5.6%	1.72	1.76
28	71%	3.1%	49%	5.7%	1.67	1.73
27	55%	7.2%	49%	5.8%	1.61	1.70
26	48%	7.8%	48%	5.9%	1.56	1.67
25	52%	10.8%	48%	6.0%	1.51	1.64
24	52%	8.0%	47%	6.1%	1.45	1.61
23	51%	7.5%	47%	6.2%	1.40	1.58
22	69%	2.4%	47%	6.4%	1.36	1.55
21	61%	7.9%	46%	6.5%	1.31	1.52

Table 4: Parameters of the Conditional Transition Probability, Φ, Base Case

Load Factor in Year t	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
20	47%	11.7%	46%	6.6%	1.26	1.49
19	50%	5.1%	45%	6.7%	1.22	1.46
18	52%	8.7%	45%	6.9%	1.17	1.43
17	37%	7.2%	45%	7.0%	1.13	1.40
16	58%	7.2%	44%	7.1%	1.09	1.37
15	66%	3.6%	44%	7.3%	1.05	1.34
14	48%	11.5%	43%	7.4%	1.01	1.31
13	41%	12.7%	43%	7.5%	0.97	1.28
12	55%	9.8%	43%	7.7%	0.93	1.25
11	61%	6.9%	42%	7.8%	0.90	1.22
10	65%	7.3%	42%	8.0%	0.86	1.19
9	57%	6.7%	42%	8.1%	0.83	1.16
8	66%	4.0%	41%	8.3%	0.79	1.13
7	61%	9.5%	41%	8.4%	0.76	1.10
6	69%	3.0%	41%	8.6%	0.73	1.07
5	64%	5.3%	40%	8.8%	0.70	1.04
4	46%	5.6%	40%	8.9%	0.67	1.01
3	58%	6.8%	39%	9.1%	0.64	0.98
2	52%	9.9%	39%	9.3%	0.61	0.95
1	56%	10.4%	39%	9.5%	0.59	0.92
0	21%	8.8%	38%	9.6%	0.56	0.90
start-up	52%	9.5%			0.85	0.79

Table 5: Regressions of Sample Mean and Sample Variance on Load Factor in Year *t* , Base Case

Dependent Variable: Log Sample Mean

	Coefficient	Std. Error	t-ratio	p-value
Constant	-1.11883	0.181954	-6.149	0.0000
lf_initial	0.01072	0.002329	4.602	0.0000

Mean dependent var	-0.500483	S.D. dependent var	0.251130
Sum squared resid	203.8265	S.E. of regression	1.434871
R-squared	0.788277	Adjusted R-squared	0.786139
F(1,99)	368.5927	P-Value (F)	3.79E-35
Log-likelihood	-178.7713	Akaike criterion	361.5426
Schwartz criterion	366.7728	Hannan-Quinn	363.6600

Dependent Variable: Log Sample Variance

	Coefficient	Std. Error	t-ratio	p-value
Constant	-2.278540	0.0585199	-23.28	0.0000
lf_initial	-0.0188012	0.0009626	-13.88	0.0000

Mean dependent var	-3.187415	S.D. dependent var	0.606725
Sum squared resid	481.3721	S.E. of regression	2.205072
R-squared	0.829131	Adjusted R-squared	0.827405
F(1,99)	480.3910	P-Value (F)	9.11E-40
Log-likelihood	-222.1696	Akaike criterion	448.3391
Schwartz criterion	453.5693	Hannan-Quinn	450.4565

Table 6a: Permanent Shutdowns From IAEA PRIS Categorization

Reactor	Shutdown Date	Reason for shutdown according to IAEA 1	2	3	4	5	6	7	8	9	10	Our Categorization
BIG ROCK POINT	8/29/1997	0	1	0	0	0	0	0	0	0	0	Vol
BOHUNICE-1	12/31/2006	0	0	0	0	0	0	1	0	0	0	Vol
BOHUNICE-2	12/31/2008	0	0	0	0	0	0	1	0	0	0	Vol
BR-3	6/30/1987	0	1	0	0	1	0	0	0	0	0	Vol
CAORSO	7/1/1990	0	0	0	0	0	0	1	0	1	0	Vol
DODEWAARD	3/26/1997	0	1	0	0	0	0	0	0	1	0	Vol
DOUGLAS POINT	5/4/1984	0	1	0	0	0	0	0	0	0	0	Vol
DRESDEN-1	10/31/1978	0	0	0	0	0	1	0	0	0	0	Vol
GREIFSWALD-1 (KGR 1)	2/14/1990	0	0	1	0	0	1	1	0	0	0	Vol
GREIFSWALD-2 (KGR 2)	2/14/1990	0	0	1	0	0	1	1	0	0	0	Vol
GREIFSWALD-3 (KGR 3)	2/28/1990	0	0	1	0	0	1	0	0	0	0	Vol
GREIFSWALD-4 (KGR 4)	7/22/1990	0	0	1	0	1	0	1	0	0	0	Vol
HAMAOKA-1	1/30/2009	0	0	0	0	0	1	0	0	0	0	Vol
HAMAOKA-2	1/30/2009	0	0	0	0	0	1	0	0	0	0	Vol
HUMBOLDT BAY	7/2/1976	0	0	0	0	1	0	0	0	0	0	Vol
IGNALINA-2	12/31/2009	0	0	0	0	0	0	1	0	0	0	Vol
INDIAN POINT-1	10/31/1974	0	0	0	0	1	0	0	0	0	0	Vol
LINGEN (KWL)	1/5/1979	0	1	0	0	0	0	0	0	0	0	Vol
MAINE YANKEE	8/1/1997	0	0	0	0	0	1	0	0	0	0	Vol
MILLSTONE-1	7/1/1998	0	0	0	0	0	1	0	0	0	0	Vol
OBRIGHEIM (KWO)	5/11/2005	0	0	0	0	0	0	0	0	0	1	Vol
PEACH BOTTOM-1	11/1/1974	1	0	0	0	0	0	0	0	0	0	Vol
RANCHO SECO-1	6/7/1989	0	0	0	0	1	1	0	0	0	0	Vol
STADE (KKS)	11/14/2003	0	1	0	0	0	0	0	0	0	0	Vol
TROJAN	11/9/1992	0	0	0	0	0	1	0	0	0	0	Vol
WUERGASSEN (KWW)	8/26/1994	0	1	0	0	0	0	0	0	0	0	Vol
ZION-1	1/1/1998	0	0	0	0	1	1	0	0	0	0	Vol
ZION-2	1/1/1998	0	0	0	0	1	1	0	0	0	0	Vol
THREE MILE ISLAND-2	3/28/1979	0	0	0	1	0	0	0	0	0	0	Inv
ARMENIA-1	2/25/1989	0	0	0	0	0	0	0	0	1	0	Inv
BARSEBACK-1	11/30/1999	0	0	0	0	0	0	0	0	1	0	Inv
BARSEBACK-2	5/31/2005	0	0	0	0	0	0	0	0	1	0	Inv
CHOOZ-A (ARDENNES)	10/30/1991	0	0	0	0	0	0	0	0	1	0	Inv
GARIGLIANO	3/1/1982	0	0	1	1	0	0	0	0	1	0	Inv
KOZLODUY-1	12/31/2002	0	0	0	0	0	0	0	0	1	0	Inv
KOZLODUY-2	12/31/2002	0	0	0	0	0	0	0	0	1	0	Inv
KOZLODUY-3	12/31/2006	0	0	0	0	0	0	0	0	1	0	Inv
KOZLODUY-4	12/31/2006	0	0	0	0	0	0	0	0	1	0	Inv
NOVOVORONEZH-2	8/29/1990	0	0	0	0	0	0	0	0	1	0	Inv
SAN ONOFRE-1	11/30/1992	0	0	0	0	0	0	0	0	1	0	Inv
MUELHEIM-KAERLICH (KMK)	9/9/1988	0	0	0	0	0	0	0	0	0	1	Inv

Reasons for shutdown

1 = technological obsolescence

2 = unprofitability

3 = change in license requirements

4 = operating incident

5 = other technological reasons

6 = other economical reasons

7 = public acceptance/political reasons

8 = component deterioriation or failure

9 = other reasons

10 = reason not given

Voluntary - 1,2,3,5,6,7

Involuntary - 4,8,9,10 (assumed involuntary if reason is not specified or disclosed)

All reactors shutdown for involuntary reasons (if given and specified) are classified as 'involuntary' regardless of other reasons listed.

Table 6b: Reactors reporting extended dormancy

Reactor	Start of Dormancy	Consecutive Years of Dormancy	Operational at Year End 2008	Restarted as of 2009	Base case classification for dormancy period: Permanent shutdown	Base case classification for dormancy period: New reactor upon restart
Browns Ferry 1	1985	21	1	1	1	1
Browns Ferry 2	1985	6	1	1	1	1
Browns Ferry 3	1985	9	1	1	1	1
Bruce 1	1997	13	1	0	1	0
Bruce 2	1995	15	1	0	1	0
Bruce 3	1998	5	1	1	1	1
Bruce 4	1998	4	1	1	1	1
Pickering 1	1997	7	1	1	1	1
Pickering 2	1997	13	1	0	1	0
Pickering 3	1997	13	1	0	1	0
Pickering 4	1997	6	1	1	1	1
Armenia 2	1989	6	1	1	0	
Hamaoka 1	2001	7	1	0	0	
Hamaoka 2	2004	4	1	0	0	
Barsebäck 2	1996	7	0	0	0	

Notes

Extended dormancy is defined as 4+ consecutive years with no commercial power generation.

In the database, years of dormancy include only calendar years without commercial power production.

Hamaoka 1 and 2 were permanently shut down as of January 2009 but are classified as operational during the date range of the database.

Barsebäck 2 was closed in 1997 due to government decision to phase out nuclear power (reversed as of June 2010 and then reversed again

Bruce 1 and 2 are scheduled to restart IN 2012.

Table 7: Shutdown Probabilities, Θ, Base Case

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	0.248%	0.016%
99	0	0.257%	0.017%
98	0	0.266%	0.017%
97	0	0.275%	0.018%
96	0	0.285%	0.018%
95	0	0.295%	0.019%
94	0.621%	0.306%	0.020%
93	0	0.316%	0.020%
92	0	0.327%	0.021%
91	0	0.339%	0.022%
90	0	0.351%	0.023%
89	0	0.363%	0.023%
88	0	0.376%	0.024%
87	0.352%	0.389%	0.025%
86	0	0.403%	0.026%
85	0.676%	0.417%	0.027%
84	0	0.432%	0.028%
83	0.317%	0.447%	0.029%
82	0	0.463%	0.030%
81	0	0.480%	0.031%
80	0	0.496%	0.032%
79	0	0.514%	0.033%
78	0	0.532%	0.034%
77	0	0.551%	0.035%
76	0.382%	0.570%	0.037%
75	0.361%	0.590%	0.038%
74	0	0.611%	0.039%
73	0	0.633%	0.041%
72	0	0.655%	0.042%
71	0	0.678%	0.044%
70	0	0.702%	0.045%
69	1.170%	0.727%	0.047%
68	0	0.753%	0.048%
67	0.556%	0.779%	0.050%
66	0	0.807%	0.052%
65	0	0.835%	0.054%
64	0	0.865%	0.056%
63	0	0.895%	0.058%
62	0	0.927%	0.060%
61	0	0.959%	0.062%

Table 7: Shutdown Probabilities, Θ, Base Case

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	0.855%	0.993%	0.064%
59	0.935%	1.028%	0.066%
58	0	1.065%	0.068%
57	0	1.102%	0.071%
56	0	1.141%	0.073%
55	0	1.181%	0.076%
54	0	1.223%	0.079%
53	0	1.266%	0.081%
52	0	1.311%	0.084%
51	0	1.357%	0.087%
50	0	1.405%	0.090%
49	0	1.454%	0.094%
48	0	1.506%	0.097%
47	0	1.559%	0.100%
46	0	1.614%	0.104%
45	0	1.671%	0.107%
44	0	1.730%	0.111%
43	0	1.791%	0.115%
42	0	1.854%	0.119%
41	0	1.919%	0.123%
40	0	1.987%	0.128%
39	0	2.057%	0.132%
38	0	2.130%	0.137%
37	0	2.205%	0.142%
36	0	2.283%	0.147%
35	0	2.363%	0.152%
34	0	2.447%	0.157%
33	0	2.533%	0.163%
32	0	2.622%	0.169%
31	0	2.715%	0.175%
30	0	2.811%	0.181%
29	0	2.910%	0.187%
28	0	3.012%	0.194%
27	0	3.119%	0.201%
26	0	3.229%	0.208%
25	0	3.343%	0.215%
24	0	3.461%	0.223%
23	0	3.583%	0.230%
22	0	3.709%	0.239%
21	0	3.840%	0.247%

Table 7: Shutdown Probabilities, Θ, Base Case

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	3.975%	0.256%
19	0	4.116%	0.265%
18	0	4.261%	0.274%
17	0	4.411%	0.284%
16	0	4.567%	0.294%
15	0	4.728%	0.304%
14	0	4.895%	0.315%
13	0	5.067%	0.326%
12	0	5.246%	0.337%
11	0	5.431%	0.349%
10	0	5.623%	0.362%
9	0	5.821%	0.374%
8	0	6.027%	0.388%
7	0	6.239%	0.401%
6	8.333%	6.460%	0.415%
5	0	6.687%	0.430%
4	0	6.923%	0.445%
3	0	7.168%	0.461%
2	0	7.421%	0.477%
1	0	7.682%	0.494%
0	0	7.953%	0.512%
start-up	NA	NA	NA

Table 8: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Base Case

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1	54%	9.6%	54%	9.6%
2	64%	7.0%	64%	7.0%
3	70%	5.5%	70%	5.5%
4	73%	4.7%	73%	4.8%
5	74%	4.4%	75%	4.4%
6	75%	4.2%	76%	4.2%
7	76%	4.1%	76%	4.1%
8	76%	4.0%	76%	4.0%
9	76%	4.0%	77%	4.0%
10	76%	3.9%	77%	4.0%
11	76%	3.9%	77%	4.0%
12	76%	3.9%	77%	4.0%
13	76%	3.9%	77%	3.9%
14	76%	3.9%	77%	3.9%
15	76%	3.9%	77%	3.9%
16	76%	3.9%	77%	3.9%
17	76%	3.9%	77%	3.9%
18	76%	3.9%	77%	3.9%
19	76%	3.9%	77%	3.9%
20	76%	3.9%	77%	3.9%
21	76%	3.9%	77%	3.9%
22	76%	3.9%	77%	3.9%
23	76%	3.9%	77%	3.9%
24	76%	3.9%	77%	3.9%
25	76%	3.9%	77%	3.9%
26	76%	3.9%	77%	3.9%
27	76%	3.9%	77%	3.9%
28	76%	3.9%	77%	3.9%
29	76%	3.9%	77%	3.9%
30	76%	3.9%	77%	3.9%
31	76%	3.9%	77%	3.9%
32	76%	3.9%	77%	3.9%
33	76%	3.9%	77%	3.9%
34	76%	3.9%	77%	3.9%
35	76%	3.9%	77%	3.9%
36	76%	3.9%	77%	3.9%
37	76%	3.9%	77%	3.9%
38	76%	3.9%	77%	3.9%
39	76%	3.9%	77%	3.9%

Table 8: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Base Case

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40	76%	3.9%	77%	3.9%
41	76%	3.9%	77%	3.9%
42	76%	3.9%	77%	3.9%
43	75%	3.9%	77%	3.9%
44	75%	3.9%	77%	3.9%
45	75%	3.9%	77%	3.9%
46	75%	3.9%	77%	3.9%
47	75%	3.9%	77%	3.9%
48	75%	3.9%	77%	3.9%
49	75%	3.9%	77%	3.9%
50	75%	3.9%	77%	3.9%
51	75%	3.9%	77%	3.9%
52	75%	3.9%	77%	3.9%
53	75%	3.9%	77%	3.9%
54	75%	3.9%	77%	3.9%
55	75%	3.9%	77%	3.9%
56	75%	3.9%	77%	3.9%
57	75%	3.9%	77%	3.9%
58	75%	3.9%	77%	3.9%
59	75%	3.9%	77%	3.9%
60	75%	3.9%	77%	3.9%

Table A1: Sample Capacity Factor Data from PRIS

			Country & Reactor			
			France	South Korea	Japan	United States
	Data Label	Units	Cattenom-1	Wolsong-4	Genkai-4	Sequoyah-1
	[A]	[B]	[C]	[D]	[E]	[F]
[1]	RUP	MW	1,300	685	1,127	1,150
[2]	T	h	8,766	8,766	8,766	8,766
[3]	t	h	8,432	8,163	8,766	7,674
[4]	REG	MWh	11,395,800	6,004,710	9,879,282	10,080,900
[5]	EG	MWh	9,698,200	5,770,400	10,025,300	8,758,300
[6]	PUF	%	0.2	6.6	0.0	12.5
[7]	UUF	%	5.9	0.6	0.0	0.0
[8]	XUF	%	1.5	0.0	0.0	0.0
[9]	OF	%	96.2	93.1	100.0	87.5
[10]	LF	%	85.1	96.1	101.5	86.9
[11]	EAF	%	92.4	92.8	100.0	87.5
[12]	UCF	%	93.9	92.8	100.0	87.5

Notes:

All figures as reported for 2007 annual. The following relationships hold:

[9]= 100 x [3]/[2].

[10]= 100 x [5]/[4].

[11]= 100 - [6] - [7] - [8].

[12]= 100 - [6] - [7].

Table A2: Parameters of the Conditional Transition Probability, Φ, year 0-5

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
100	78%	2.6%	82%	1.3%	8.85	1.99
99	82%	0.6%	81%	1.3%	8.82	2.03
98	79%	1.3%	81%	1.3%	8.77	2.07
97	82%	0.3%	81%	1.3%	8.73	2.11
96	82%	2.4%	80%	1.3%	8.68	2.15
95	69%	3.8%	80%	1.4%	8.62	2.19
94	73%	7.1%	79%	1.4%	8.56	2.22
93	88%	0.7%	79%	1.4%	8.50	2.26
92	79%	1.1%	79%	1.4%	8.43	2.29
91	81%	1.2%	78%	1.5%	8.36	2.33
90	81%	0.6%	78%	1.5%	8.29	2.36
89	79%	3.0%	77%	1.5%	8.22	2.39
88	82%	1.5%	77%	1.5%	8.14	2.41
87	82%	0.8%	77%	1.6%	8.06	2.44
86	82%	0.6%	76%	1.6%	7.98	2.47
85	78%	1.1%	76%	1.6%	7.89	2.49
84	77%	2.3%	76%	1.6%	7.81	2.51
83	80%	0.9%	75%	1.7%	7.72	2.53
82	75%	3.5%	75%	1.7%	7.63	2.55
81	73%	3.4%	75%	1.7%	7.54	2.57
80	78%	1.6%	74%	1.7%	7.45	2.59
79	77%	1.2%	74%	1.8%	7.36	2.60
78	76%	1.6%	74%	1.8%	7.27	2.62
77	77%	3.0%	73%	1.8%	7.17	2.63
76	71%	2.4%	73%	1.8%	7.08	2.64
75	74%	1.7%	72%	1.9%	6.99	2.65
74	75%	1.4%	72%	1.9%	6.89	2.66
73	71%	1.8%	72%	1.9%	6.79	2.67
72	69%	1.3%	71%	2.0%	6.70	2.68
71	70%	3.4%	71%	2.0%	6.60	2.68
70	73%	2.6%	71%	2.0%	6.51	2.69
69	65%	2.2%	70%	2.1%	6.41	2.69
68	66%	2.2%	70%	2.1%	6.31	2.70
67	72%	1.6%	70%	2.1%	6.22	2.70
66	66%	4.0%	69%	2.2%	6.12	2.70
65	66%	2.9%	69%	2.2%	6.03	2.70
64	65%	2.6%	69%	2.2%	5.93	2.70
63	67%	1.0%	68%	2.3%	5.84	2.69
62	60%	3.7%	68%	2.3%	5.74	2.69
61	62%	4.3%	68%	2.3%	5.65	2.69

Table A2: Parameters of the Conditional Transition Probability, Φ, year 0-5

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	65%	3.2%	67%	2.4%	5.56	2.68
59	65%	1.6%	67%	2.4%	5.46	2.68
58	66%	1.9%	67%	2.5%	5.37	2.67
57	64%	3.0%	66%	2.5%	5.28	2.66
56	64%	1.9%	66%	2.5%	5.19	2.65
55	60%	3.2%	66%	2.6%	5.10	2.64
54	61%	1.4%	66%	2.6%	5.01	2.63
53	59%	4.2%	65%	2.7%	4.92	2.62
52	64%	2.2%	65%	2.7%	4.83	2.61
51	64%	1.8%	65%	2.7%	4.75	2.60
50	62%	1.0%	64%	2.8%	4.66	2.59
49	63%	4.8%	64%	2.8%	4.57	2.57
48	62%	3.0%	64%	2.9%	4.49	2.56
47	63%	3.3%	63%	2.9%	4.41	2.55
46	55%	10.2%	63%	3.0%	4.32	2.53
45	59%	3.2%	63%	3.0%	4.24	2.52
44	59%	1.7%	62%	3.1%	4.16	2.50
43	71%	0.6%	62%	3.1%	4.08	2.48
42	47%	7.5%	62%	3.2%	4.00	2.47
41	54%	4.6%	62%	3.2%	3.92	2.45
40	48%	3.6%	61%	3.3%	3.85	2.43
39	50%	6.4%	61%	3.3%	3.77	2.41
38	64%	3.0%	61%	3.4%	3.70	2.39
37	62%	3.0%	60%	3.4%	3.62	2.37
36	62%	6.1%	60%	3.5%	3.55	2.35
35	57%	5.5%	60%	3.5%	3.48	2.33
34	52%	12.2%	60%	3.6%	3.41	2.31
33	56%	7.9%	59%	3.6%	3.34	2.29
32	67%	5.3%	59%	3.7%	3.27	2.27
31	74%	1.4%	59%	3.8%	3.20	2.25
30	68%	7.7%	58%	3.8%	3.13	2.23
29	71%	10.5%	58%	3.9%	3.07	2.21
28	71%	1.0%	58%	3.9%	3.00	2.19
27	67%	1.1%	58%	4.0%	2.94	2.16
26	53%	6.9%	57%	4.1%	2.87	2.14
25	69%	1.9%	57%	4.1%	2.81	2.12
24	50%	11.6%	57%	4.2%	2.75	2.10
23	55%	5.0%	56%	4.3%	2.69	2.07
22	63%	1.6%	56%	4.3%	2.63	2.05
21	80%	1.1%	56%	4.4%	2.57	2.03

Table A2: Parameters of the Conditional Transition Probability, Φ, year 0-5

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	65%	5.9%	56%	4.5%	2.52	2.00
19	59%	2.3%	55%	4.5%	2.46	1.98
18	55%	6.2%	55%	4.6%	2.41	1.95
17	45%	5.9%	55%	4.7%	2.35	1.93
16	65%	2.8%	55%	4.8%	2.30	1.91
15	66%	4.9%	54%	4.8%	2.24	1.88
14	37%	9.2%	54%	4.9%	2.19	1.86
13	43%	11.2%	54%	5.0%	2.14	1.83
12	58%	4.9%	54%	5.1%	2.09	1.81
11	55%	9.0%	53%	5.2%	2.04	1.79
10	74%	1.8%	53%	5.2%	1.99	1.76
9	60%	7.9%	53%	5.3%	1.95	1.74
8	64%	3.8%	53%	5.4%	1.90	1.71
7	69%	7.0%	52%	5.5%	1.85	1.69
6	64%	2.8%	52%	5.6%	1.81	1.66
5	60%	6.0%	52%	5.7%	1.77	1.64
4	60%	2.4%	52%	5.8%	1.72	1.62
3	30%	3.4%	51%	5.8%	1.68	1.59
2	36%	2.8%	51%	5.9%	1.64	1.57
1	50%	8.7%	51%	6.0%	1.60	1.54
0	48%	8.7%	51%	6.1%	1.56	1.52
start-up	54%	9.6%			0.85	0.74

Table A3: Shutdown Probabilities, Θ, year 0-5

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	2.526%	0.110%
99	0	2.569%	0.112%
98	0	2.612%	0.113%
97	0	2.656%	0.115%
96	0	2.701%	0.117%
95	0	2.746%	0.119%
94	7.692%	2.792%	0.121%
93	0	2.839%	0.123%
92	0	2.887%	0.125%
91	0	2.935%	0.127%
90	0	2.985%	0.130%
89	0	3.035%	0.132%
88	0	3.086%	0.134%
87	0	3.138%	0.136%
86	0	3.191%	0.139%
85	0	3.245%	0.141%
84	0	3.299%	0.143%
83	0	3.355%	0.146%
82	0	3.411%	0.148%
81	0	3.469%	0.151%
80	0	3.527%	0.153%
79	0	3.586%	0.156%
78	0	3.647%	0.158%
77	0	3.708%	0.161%
76	0	3.770%	0.164%
75	1.587%	3.834%	0.166%
74	0	3.898%	0.169%
73	0	3.964%	0.172%
72	0	4.031%	0.175%
71	0	4.098%	0.178%
70	0	4.167%	0.181%
69	2.703%	4.238%	0.184%
68	0	4.309%	0.187%
67	0	4.381%	0.190%
66	0	4.455%	0.193%
65	0	4.530%	0.197%
64	0	4.606%	0.200%
63	0	4.684%	0.203%
62	0	4.763%	0.207%
61	0	4.843%	0.210%

Table A3: Shutdown Probabilities, Θ, year 0-5

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	0	4.924%	0.214%
59	0	5.007%	0.217%
58	0	5.091%	0.221%
57	0	5.177%	0.225%
56	0	5.264%	0.229%
55	0	5.353%	0.232%
54	0	5.443%	0.236%
53	0	5.534%	0.240%
52	0	5.627%	0.244%
51	0	5.722%	0.248%
50	0	5.818%	0.253%
49	0	5.916%	0.257%
48	0	6.016%	0.261%
47	0	6.117%	0.266%
46	0	6.220%	0.270%
45	0	6.325%	0.275%
44	0	6.431%	0.279%
43	0	6.539%	0.284%
42	0	6.649%	0.289%
41	0	6.761%	0.294%
40	0	6.875%	0.299%
39	0	6.991%	0.304%
38	0	7.108%	0.309%
37	0	7.228%	0.314%
36	0	7.350%	0.319%
35	0	7.473%	0.325%
34	0	7.599%	0.330%
33	0	7.727%	0.336%
32	0	7.857%	0.341%
31	0	7.989%	0.347%
30	0	8.124%	0.353%
29	0	8.260%	0.359%
28	0	8.399%	0.365%
27	0	8.541%	0.371%
26	0	8.684%	0.377%
25	0	8.830%	0.383%
24	0	8.979%	0.390%
23	0	9.130%	0.396%
22	0	9.284%	0.403%
21	0	9.440%	0.410%

Table A3: Shutdown Probabilities, Θ, year 0-5

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	9.599%	0.417%
19	0	9.760%	0.424%
18	0	9.925%	0.431%
17	0	10.092%	0.438%
16	0	10.261%	0.446%
15	0	10.434%	0.453%
14	0	10.610%	0.461%
13	0	10.788%	0.468%
12	0	10.970%	0.476%
11	0	11.154%	0.484%
10	0	11.342%	0.493%
9	0	11.533%	0.501%
8	0	11.727%	0.509%
7	0	11.924%	0.518%
6	16.667%	12.125%	0.527%
5	0	12.329%	0.535%
4	0	12.536%	0.544%
3	0	12.747%	0.554%
2	0	12.962%	0.563%
1	0	13.180%	0.572%
0	0	13.402%	0.582%
start-up	NA	NA	NA

Table A4: Parameters of the Conditional Transition Probability, Φ, year 5+

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
100	85%	1.1%	95%	1.5%	2.04	0.10
99	83%	1.3%	94%	1.5%	2.50	0.15
98	82%	1.9%	93%	1.5%	2.91	0.21
97	84%	0.9%	92%	1.6%	3.29	0.27
96	81%	2.3%	91%	1.6%	3.62	0.34
95	85%	1.8%	90%	1.6%	3.92	0.41
94	84%	1.8%	90%	1.7%	4.19	0.49
93	87%	1.7%	89%	1.7%	4.42	0.57
92	87%	1.4%	88%	1.7%	4.63	0.65
91	87%	1.6%	87%	1.7%	4.80	0.73
90	86%	1.8%	86%	1.8%	4.96	0.81
89	86%	1.5%	85%	1.8%	5.09	0.89
88	84%	2.6%	84%	1.9%	5.19	0.97
87	84%	2.2%	83%	1.9%	5.28	1.05
86	83%	2.0%	83%	1.9%	5.35	1.13
85	82%	2.2%	82%	2.0%	5.41	1.21
84	81%	1.8%	81%	2.0%	5.44	1.29
83	82%	1.6%	80%	2.0%	5.47	1.36
82	79%	2.0%	79%	2.1%	5.48	1.43
81	81%	1.8%	78%	2.1%	5.47	1.50
80	78%	2.4%	78%	2.2%	5.46	1.57
79	79%	1.9%	77%	2.2%	5.44	1.63
78	77%	2.1%	76%	2.2%	5.41	1.70
77	77%	2.0%	75%	2.3%	5.37	1.76
76	77%	2.9%	75%	2.3%	5.32	1.81
75	73%	2.1%	74%	2.4%	5.27	1.86
74	74%	2.5%	73%	2.4%	5.21	1.92
73	73%	2.6%	72%	2.5%	5.14	1.96
72	76%	2.5%	72%	2.5%	5.07	2.01
71	74%	3.0%	71%	2.6%	4.99	2.05
70	72%	2.5%	70%	2.6%	4.92	2.09
69	71%	3.2%	69%	2.7%	4.83	2.12
68	70%	4.3%	69%	2.7%	4.75	2.15
67	71%	3.3%	68%	2.8%	4.66	2.18
66	73%	2.9%	67%	2.8%	4.57	2.21
65	66%	4.0%	67%	2.9%	4.48	2.23
64	70%	3.7%	66%	2.9%	4.39	2.26
63	66%	4.4%	65%	3.0%	4.30	2.27
62	65%	4.4%	65%	3.0%	4.20	2.29
61	68%	3.2%	64%	3.1%	4.11	2.30

Table A4: Parameters of the Conditional Transition Probability, Φ, year 5+

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	66%	2.7%	63%	3.2%	4.01	2.31
59	67%	4.1%	63%	3.2%	3.92	2.32
58	68%	3.4%	62%	3.3%	3.82	2.33
57	66%	3.7%	62%	3.4%	3.73	2.33
56	68%	3.3%	61%	3.4%	3.63	2.33
55	60%	3.7%	60%	3.5%	3.54	2.33
54	64%	4.6%	60%	3.6%	3.45	2.33
53	61%	3.5%	59%	3.6%	3.36	2.32
52	68%	4.4%	58%	3.7%	3.26	2.32
51	58%	4.3%	58%	3.8%	3.17	2.31
50	68%	2.8%	57%	3.8%	3.08	2.30
49	55%	5.5%	57%	3.9%	3.00	2.28
48	56%	3.7%	56%	4.0%	2.91	2.27
47	63%	3.6%	56%	4.1%	2.82	2.26
46	67%	3.7%	55%	4.1%	2.74	2.24
45	56%	3.8%	54%	4.2%	2.66	2.22
44	64%	2.1%	54%	4.3%	2.58	2.20
43	57%	3.3%	53%	4.4%	2.50	2.18
42	63%	4.6%	53%	4.5%	2.42	2.16
41	63%	2.2%	52%	4.6%	2.34	2.13
40	59%	1.6%	52%	4.6%	2.27	2.11
39	55%	4.8%	51%	4.7%	2.19	2.09
38	62%	6.6%	51%	4.8%	2.12	2.06
37	48%	3.4%	50%	4.9%	2.05	2.03
36	55%	7.1%	50%	5.0%	1.98	2.00
35	60%	4.0%	49%	5.1%	1.92	1.98
34	76%	2.6%	49%	5.2%	1.85	1.95
33	58%	9.6%	48%	5.3%	1.79	1.92
32	56%	7.0%	48%	5.4%	1.72	1.89
31	74%	0.7%	47%	5.5%	1.66	1.86
30	61%	4.1%	47%	5.6%	1.60	1.82
29	66%	2.0%	46%	5.7%	1.55	1.79
28	70%	4.4%	46%	5.8%	1.49	1.76
27	49%	9.2%	45%	6.0%	1.44	1.73
26	44%	9.3%	45%	6.1%	1.38	1.69
25	49%	11.7%	44%	6.2%	1.33	1.66
24	54%	7.0%	44%	6.3%	1.28	1.63
23	48%	11.7%	44%	6.4%	1.23	1.59
22	74%	2.6%	43%	6.6%	1.18	1.56
21	48%	7.9%	43%	6.7%	1.14	1.53

Table A4: Parameters of the Conditional Transition Probability, Φ, year 5+

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	37%	12.1%	42%	6.8%	1.09	1.49
19	45%	6.0%	42%	6.9%	1.05	1.46
18	45%	13.8%	41%	7.1%	1.01	1.42
17	30%	7.3%	41%	7.2%	0.97	1.39
16	52%	11.6%	41%	7.4%	0.93	1.35
15	67%	2.1%	40%	7.5%	0.89	1.32
14	56%	11.6%	40%	7.6%	0.85	1.29
13	40%	14.3%	39%	7.8%	0.81	1.25
12	49%	16.8%	39%	7.9%	0.78	1.22
11	72%	1.0%	39%	8.1%	0.74	1.18
10	40%	13.7%	38%	8.2%	0.71	1.15
9	53%	4.5%	38%	8.4%	0.68	1.12
8	95%	0.0%	37%	8.6%	0.65	1.08
7	47%	11.3%	37%	8.7%	0.62	1.05
6	91%	0.0%	37%	8.9%	0.59	1.02
5	77%	0.8%	36%	9.1%	0.56	0.99
4	27%	3.5%	36%	9.3%	0.54	0.95
3	70%	3.5%	36%	9.4%	0.51	0.92
2	67%	12.3%	35%	9.6%	0.48	0.89
1	85%	0.9%	35%	9.8%	0.46	0.86
0	19%	8.3%	35%	10.0%	0.44	0.83
start-up	NA	NA			NA	NA

Table A5: Shutdown Probabilities, Θ, year 5+

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	0.308%	0.008%
99	0	0.319%	0.008%
98	0	0.329%	0.008%
97	0	0.341%	0.009%
96	0	0.352%	0.009%
95	0	0.364%	0.009%
94	0	0.377%	0.010%
93	0	0.390%	0.010%
92	0	0.403%	0.010%
91	0	0.416%	0.011%
90	0	0.431%	0.011%
89	0	0.445%	0.011%
88	0	0.460%	0.012%
87	0.444%	0.476%	0.012%
86	0	0.492%	0.013%
85	0.851%	0.509%	0.013%
84	0	0.526%	0.013%
83	0.415%	0.544%	0.014%
82	0	0.563%	0.014%
81	0	0.582%	0.015%
80	0	0.602%	0.015%
79	0	0.622%	0.016%
78	0	0.644%	0.016%
77	0	0.665%	0.017%
76	0.541%	0.688%	0.018%
75	0	0.712%	0.018%
74	0	0.736%	0.019%
73	0	0.761%	0.019%
72	0	0.787%	0.020%
71	0	0.814%	0.021%
70	0	0.841%	0.021%
69	0.855%	0.870%	0.022%
68	0	0.899%	0.023%
67	0.847%	0.930%	0.024%
66	0	0.962%	0.025%
65	0	0.994%	0.025%
64	0	1.028%	0.026%
63	0	1.063%	0.027%
62	0	1.100%	0.028%
61	0	1.137%	0.029%

Table A5: Shutdown Probabilities, Θ, year 5+

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	1.316%	1.176%	0.030%
59	1.299%	1.216%	0.031%
58	0	1.257%	0.032%
57	0	1.300%	0.033%
56	0	1.344%	0.034%
55	0	1.390%	0.036%
54	0	1.437%	0.037%
53	0	1.486%	0.038%
52	0	1.537%	0.039%
51	0	1.589%	0.041%
50	0	1.643%	0.042%
49	0	1.699%	0.043%
48	0	1.757%	0.045%
47	0	1.817%	0.046%
46	0	1.878%	0.048%
45	0	1.942%	0.050%
44	0	2.009%	0.051%
43	0	2.077%	0.053%
42	0	2.148%	0.055%
41	0	2.221%	0.057%
40	0	2.296%	0.059%
39	0	2.375%	0.061%
38	0	2.455%	0.063%
37	0	2.539%	0.065%
36	0	2.625%	0.067%
35	0	2.715%	0.069%
34	0	2.807%	0.072%
33	0	2.903%	0.074%
32	0	3.002%	0.077%
31	0	3.104%	0.079%
30	0	3.209%	0.082%
29	0	3.319%	0.085%
28	0	3.432%	0.088%
27	0	3.548%	0.091%
26	0	3.669%	0.094%
25	0	3.794%	0.097%
24	0	3.923%	0.100%
23	0	4.057%	0.104%
22	0	4.195%	0.107%
21	0	4.338%	0.111%

Table A5: Shutdown Probabilities, Θ, year 5+

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	4.485%	0.115%
19	0	4.638%	0.118%
18	0	4.796%	0.123%
17	0	4.959%	0.127%
16	0	5.128%	0.131%
15	0	5.303%	0.135%
14	0	5.483%	0.140%
13	0	5.670%	0.145%
12	0	5.863%	0.150%
11	0	6.062%	0.155%
10	0	6.269%	0.160%
9	0	6.482%	0.166%
8	0	6.703%	0.171%
7	0	6.931%	0.177%
6	0	7.167%	0.183%
5	0	7.411%	0.189%
4	0	7.663%	0.196%
3	0	7.924%	0.202%
2	0	8.194%	0.209%
1	0	8.473%	0.216%
0	0	8.761%	0.224%
start-up	NA	NA	NA

Table A6: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Base Case adjusted by vintage

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
1	54%	9.6%	54%	9.6%
2	67%	3.9%	67%	3.9%
3	70%	2.6%	70%	2.7%
4	71%	2.4%	72%	2.4%
5	71%	2.3%	72%	2.3%
6	72%	3.7%	73%	3.8%
7	73%	4.4%	74%	4.5%
8	75%	4.8%	75%	4.8%
9	76%	4.9%	76%	4.9%
10	76%	4.9%	77%	5.0%
11	77%	4.9%	78%	5.0%
12	77%	4.9%	78%	4.9%
13	78%	4.9%	78%	4.9%
14	78%	4.9%	79%	4.9%
15	78%	4.8%	79%	4.9%
16	78%	4.8%	79%	4.9%
17	78%	4.8%	79%	4.9%
18	78%	4.8%	79%	4.9%
19	78%	4.8%	79%	4.8%
20	78%	4.8%	79%	4.8%
21	78%	4.8%	79%	4.8%
22	78%	4.8%	79%	4.8%
23	78%	4.8%	79%	4.8%
24	78%	4.8%	79%	4.8%
25	78%	4.8%	79%	4.8%
26	78%	4.8%	79%	4.8%
27	78%	4.8%	79%	4.8%
28	78%	4.8%	79%	4.8%
29	78%	4.8%	79%	4.8%
30	78%	4.8%	79%	4.8%
31	78%	4.8%	79%	4.8%
32	78%	4.8%	79%	4.8%
33	78%	4.8%	79%	4.8%
34	78%	4.8%	79%	4.8%
35	78%	4.8%	79%	4.8%
36	78%	4.8%	79%	4.8%
37	78%	4.8%	79%	4.8%
38	78%	4.8%	79%	4.8%
39	78%	4.8%	79%	4.8%

Table A6: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Base Case adjusted by vintage

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
40	78%	4.8%	79%	4.8%
41	78%	4.8%	79%	4.8%
42	78%	4.8%	79%	4.8%
43	78%	4.8%	79%	4.8%
44	78%	4.8%	79%	4.8%
45	78%	4.8%	79%	4.8%
46	78%	4.8%	79%	4.8%
47	78%	4.8%	79%	4.8%
48	78%	4.8%	79%	4.8%
49	78%	4.8%	79%	4.8%
50	78%	4.8%	79%	4.8%
51	78%	4.8%	79%	4.8%
52	78%	4.8%	79%	4.8%
53	78%	4.8%	79%	4.8%
54	78%	4.8%	79%	4.8%
55	78%	4.8%	79%	4.8%
56	78%	4.8%	79%	4.8%
57	78%	4.8%	79%	4.8%
58	78%	4.8%	79%	4.8%
59	78%	4.8%	79%	4.8%
60	78%	4.7%	79%	4.8%

Table A7: Parameters of the Conditional Transition Probability, Φ, pre-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
100	80%	1.3%	89%	1.6%	4.76	0.61
99	81%	0.4%	88%	1.6%	4.92	0.67
98	78%	1.1%	87%	1.6%	5.07	0.74
97	78%	0.9%	87%	1.7%	5.20	0.81
96	75%	2.3%	86%	1.7%	5.31	0.88
95	78%	2.1%	85%	1.7%	5.41	0.94
94	76%	3.3%	84%	1.8%	5.49	1.01
93	80%	2.1%	84%	1.8%	5.55	1.08
92	82%	1.1%	83%	1.8%	5.61	1.14
91	79%	2.2%	82%	1.8%	5.65	1.20
90	82%	1.6%	82%	1.9%	5.68	1.27
89	82%	1.9%	81%	1.9%	5.70	1.33
88	78%	3.6%	80%	1.9%	5.71	1.39
87	80%	2.4%	80%	2.0%	5.71	1.45
86	80%	2.0%	79%	2.0%	5.70	1.50
85	78%	2.4%	79%	2.0%	5.69	1.56
84	79%	2.2%	78%	2.1%	5.67	1.61
83	80%	1.4%	77%	2.1%	5.64	1.66
82	76%	2.6%	77%	2.2%	5.60	1.71
81	78%	2.7%	76%	2.2%	5.56	1.76
80	76%	2.9%	75%	2.2%	5.52	1.80
79	77%	2.0%	75%	2.3%	5.46	1.84
78	76%	1.9%	74%	2.3%	5.41	1.88
77	76%	2.1%	74%	2.4%	5.35	1.92
76	75%	2.7%	73%	2.4%	5.29	1.96
75	72%	2.0%	72%	2.4%	5.22	1.99
74	72%	2.6%	72%	2.5%	5.15	2.02
73	70%	2.1%	71%	2.5%	5.08	2.05
72	74%	2.3%	71%	2.6%	5.01	2.08
71	69%	3.3%	70%	2.6%	4.93	2.11
70	72%	1.8%	70%	2.7%	4.86	2.13
69	67%	3.3%	69%	2.7%	4.78	2.15
68	68%	3.1%	68%	2.7%	4.70	2.17
67	69%	2.7%	68%	2.8%	4.62	2.19
66	69%	3.9%	67%	2.8%	4.53	2.20
65	66%	3.5%	67%	2.9%	4.45	2.22
64	65%	3.9%	66%	2.9%	4.37	2.23
63	66%	2.8%	66%	3.0%	4.28	2.24
62	65%	3.3%	65%	3.0%	4.20	2.25
61	66%	3.5%	65%	3.1%	4.12	2.26

Table A7: Parameters of the Conditional Transition Probability, Φ, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	65%	3.2%	64%	3.2%	4.03	2.26
59	65%	3.2%	64%	3.2%	3.95	2.26
58	66%	3.1%	63%	3.3%	3.86	2.26
57	62%	3.8%	63%	3.3%	3.78	2.26
56	65%	3.2%	62%	3.4%	3.70	2.26
55	59%	3.2%	62%	3.4%	3.62	2.26
54	62%	2.8%	61%	3.5%	3.53	2.26
53	60%	3.7%	61%	3.6%	3.45	2.25
52	63%	3.7%	60%	3.6%	3.37	2.24
51	60%	3.8%	60%	3.7%	3.29	2.23
50	63%	2.0%	59%	3.8%	3.21	2.23
49	56%	5.1%	59%	3.8%	3.14	2.21
48	57%	3.2%	58%	3.9%	3.06	2.20
47	61%	3.6%	58%	4.0%	2.98	2.19
46	61%	3.6%	57%	4.0%	2.91	2.18
45	55%	3.6%	57%	4.1%	2.83	2.16
44	60%	2.6%	56%	4.2%	2.76	2.15
43	58%	2.6%	56%	4.2%	2.69	2.13
42	48%	5.0%	55%	4.3%	2.62	2.11
41	59%	2.7%	55%	4.4%	2.55	2.09
40	48%	4.2%	54%	4.5%	2.48	2.07
39	54%	5.2%	54%	4.5%	2.41	2.05
38	54%	5.1%	54%	4.6%	2.35	2.03
37	56%	4.6%	53%	4.7%	2.28	2.01
36	54%	5.2%	53%	4.8%	2.22	1.99
35	55%	6.0%	52%	4.9%	2.16	1.97
34	66%	8.3%	52%	5.0%	2.09	1.94
33	52%	6.4%	51%	5.0%	2.03	1.92
32	59%	7.5%	51%	5.1%	1.98	1.89
31	70%	1.4%	51%	5.2%	1.92	1.87
30	56%	7.6%	50%	5.3%	1.86	1.85
29	69%	8.1%	50%	5.4%	1.81	1.82
28	68%	3.6%	49%	5.5%	1.75	1.79
27	53%	6.8%	49%	5.6%	1.70	1.77
26	48%	6.7%	49%	5.7%	1.65	1.74
25	44%	11.4%	48%	5.8%	1.60	1.71
24	51%	6.8%	48%	5.9%	1.55	1.69
23	53%	6.2%	47%	6.0%	1.50	1.66
22	55%	7.1%	47%	6.1%	1.45	1.63
21	56%	8.1%	47%	6.2%	1.40	1.60

Table A7: Parameters of the Conditional Transition Probability, Φ, pre-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	51%	8.2%	46%	6.3%	1.36	1.58
19	52%	5.0%	46%	6.4%	1.32	1.55
18	52%	7.6%	46%	6.5%	1.27	1.52
17	30%	6.7%	45%	6.7%	1.23	1.49
16	57%	6.6%	45%	6.8%	1.19	1.46
15	62%	6.1%	44%	6.9%	1.15	1.44
14	48%	11.5%	44%	7.0%	1.11	1.41
13	38%	11.9%	44%	7.1%	1.07	1.38
12	49%	8.2%	43%	7.3%	1.03	1.35
11	52%	8.7%	43%	7.4%	1.00	1.32
10	62%	7.4%	43%	7.5%	0.96	1.29
9	52%	7.5%	42%	7.6%	0.93	1.26
8	63%	3.0%	42%	7.8%	0.90	1.24
7	58%	9.0%	42%	7.9%	0.86	1.21
6	54%	7.5%	41%	8.1%	0.83	1.18
5	58%	5.4%	41%	8.2%	0.80	1.15
4	46%	5.1%	41%	8.3%	0.77	1.12
3	51%	6.8%	40%	8.5%	0.74	1.10
2	38%	7.5%	40%	8.6%	0.71	1.07
1	50%	9.6%	40%	8.8%	0.68	1.04
0	20%	7.9%	39%	8.9%	0.66	1.01
start-up	52%	9.5%			0.85	0.79

Table A8: Shutdown Probabilities, Θ, pre-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	0.378%	0.026%
99	0	0.390%	0.026%
98	0	0.401%	0.027%
97	0	0.414%	0.028%
96	0	0.426%	0.029%
95	0	0.439%	0.030%
94	1.471%	0.452%	0.030%
93	0	0.465%	0.031%
92	0	0.479%	0.032%
91	0	0.494%	0.033%
90	0	0.508%	0.034%
89	0	0.524%	0.035%
88	0	0.539%	0.036%
87	0	0.556%	0.037%
86	0	0.572%	0.039%
85	0	0.589%	0.040%
84	0	0.607%	0.041%
83	0.521%	0.625%	0.042%
82	0	0.644%	0.043%
81	0	0.663%	0.045%
80	0	0.683%	0.046%
79	0	0.704%	0.047%
78	0	0.725%	0.049%
77	0	0.746%	0.050%
76	0.575%	0.769%	0.052%
75	0.529%	0.792%	0.053%
74	0	0.816%	0.055%
73	0	0.840%	0.057%
72	0	0.865%	0.058%
71	0	0.891%	0.060%
70	0	0.918%	0.062%
69	0.840%	0.945%	0.064%
68	0	0.974%	0.066%
67	0.704%	1.003%	0.068%
66	0	1.033%	0.070%
65	0	1.064%	0.072%
64	0	1.096%	0.074%
63	0	1.129%	0.076%
62	0	1.162%	0.078%
61	0	1.197%	0.081%

Table A8: Shutdown Probabilities, Θ, pre-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	1.053%	1.233%	0.083%
59	1.176%	1.270%	0.086%
58	0	1.308%	0.088%
57	0	1.347%	0.091%
56	0	1.388%	0.094%
55	0	1.429%	0.096%
54	0	1.472%	0.099%
53	0	1.516%	0.102%
52	0	1.562%	0.105%
51	0	1.609%	0.108%
50	0	1.657%	0.112%
49	0	1.707%	0.115%
48	0	1.758%	0.119%
47	0	1.810%	0.122%
46	0	1.865%	0.126%
45	0	1.920%	0.130%
44	0	1.978%	0.133%
43	0	2.037%	0.137%
42	0	2.098%	0.142%
41	0	2.161%	0.146%
40	0	2.226%	0.150%
39	0	2.293%	0.155%
38	0	2.361%	0.159%
37	0	2.432%	0.164%
36	0	2.505%	0.169%
35	0	2.580%	0.174%
34	0	2.658%	0.179%
33	0	2.737%	0.185%
32	0	2.819%	0.190%
31	0	2.904%	0.196%
30	0	2.991%	0.202%
29	0	3.080%	0.208%
28	0	3.173%	0.214%
27	0	3.268%	0.220%
26	0	3.366%	0.227%
25	0	3.467%	0.234%
24	0	3.571%	0.241%
23	0	3.678%	0.248%
22	0	3.788%	0.255%
21	0	3.901%	0.263%

Table A8: Shutdown Probabilities, Θ, pre-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	4.018%	0.271%
19	0	4.139%	0.279%
18	0	4.263%	0.287%
17	0	4.391%	0.296%
16	0	4.522%	0.305%
15	0	4.658%	0.314%
14	0	4.797%	0.324%
13	0	4.941%	0.333%
12	0	5.089%	0.343%
11	0	5.242%	0.354%
10	0	5.399%	0.364%
9	0	5.561%	0.375%
8	0	5.727%	0.386%
7	0	5.899%	0.398%
6	9.091%	6.076%	0.410%
5	0	6.258%	0.422%
4	0	6.445%	0.435%
3	0	6.639%	0.448%
2	0	6.838%	0.461%
1	0	7.042%	0.475%
0	0	7.254%	0.489%
start-up	NA	NA	NA

Table A9: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, pre-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1	54%	9.6%	54%	9.6%
2	63%	6.4%	63%	6.4%
3	68%	5.0%	68%	5.0%
4	70%	4.4%	70%	4.4%
5	71%	4.1%	71%	4.1%
6	71%	4.0%	71%	4.0%
7	71%	3.9%	72%	4.0%
8	71%	3.9%	72%	3.9%
9	71%	3.9%	72%	3.9%
10	71%	3.9%	72%	3.9%
11	71%	3.9%	72%	3.9%
12	71%	3.9%	72%	3.9%
13	71%	3.9%	72%	3.9%
14	71%	3.9%	72%	3.9%
15	71%	3.9%	72%	3.9%
16	71%	3.9%	72%	3.9%
17	71%	3.9%	72%	3.9%
18	71%	3.9%	72%	3.9%
19	71%	3.9%	72%	3.9%
20	71%	3.8%	72%	3.9%
21	71%	3.8%	72%	3.9%
22	71%	3.8%	72%	3.9%
23	71%	3.8%	72%	3.9%
24	71%	3.8%	72%	3.9%
25	71%	3.8%	72%	3.9%
26	71%	3.8%	72%	3.9%
27	71%	3.8%	72%	3.9%
28	71%	3.8%	72%	3.9%
29	71%	3.8%	72%	3.9%
30	70%	3.8%	72%	3.9%
31	70%	3.8%	72%	3.9%
32	70%	3.8%	72%	3.9%
33	70%	3.8%	72%	3.9%
34	70%	3.8%	72%	3.9%
35	70%	3.8%	72%	3.9%
36	70%	3.8%	72%	3.9%
37	70%	3.8%	72%	3.9%
38	70%	3.8%	72%	3.9%
39	70%	3.8%	72%	3.9%

Table A9: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, pre-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40	70%	3.8%	72%	3.9%
41	70%	3.8%	72%	3.9%
42	70%	3.8%	72%	3.9%
43	70%	3.8%	72%	3.9%
44	70%	3.8%	72%	3.9%
45	70%	3.8%	72%	3.9%
46	70%	3.8%	72%	3.9%
47	70%	3.8%	72%	3.9%
48	70%	3.8%	72%	3.9%
49	70%	3.8%	72%	3.9%
50	69%	3.8%	72%	3.9%
51	69%	3.8%	72%	3.9%
52	69%	3.8%	72%	3.9%
53	69%	3.8%	72%	3.9%
54	69%	3.8%	72%	3.9%
55	69%	3.8%	72%	3.9%
56	69%	3.8%	72%	3.9%
57	69%	3.8%	72%	3.9%
58	69%	3.8%	72%	3.9%
59	69%	3.8%	72%	3.9%
60	69%	3.8%	72%	3.9%

Table A10: Parameters of the Conditional Transition Probability, Φ, post-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	86%	1.2%	98%	1.2%	0.25	0.00
99	85%	1.6%	97%	1.3%	1.05	0.03
98	84%	2.1%	96%	1.3%	1.78	0.07
97	87%	0.6%	95%	1.3%	2.43	0.13
96	84%	2.2%	94%	1.3%	3.02	0.19
95	87%	2.0%	93%	1.4%	3.54	0.27
94	87%	1.2%	92%	1.4%	4.01	0.35
93	89%	1.4%	91%	1.4%	4.42	0.45
92	89%	1.1%	90%	1.4%	4.78	0.54
91	90%	1.1%	89%	1.5%	5.10	0.64
90	88%	1.6%	88%	1.5%	5.37	0.75
89	87%	1.6%	87%	1.5%	5.61	0.85
88	89%	1.1%	86%	1.6%	5.81	0.96
87	87%	1.7%	85%	1.6%	5.98	1.07
86	84%	1.6%	84%	1.6%	6.12	1.18
85	85%	1.4%	83%	1.7%	6.23	1.29
84	84%	1.4%	82%	1.7%	6.31	1.39
83	84%	1.6%	81%	1.7%	6.37	1.49
82	82%	1.8%	80%	1.8%	6.41	1.59
81	81%	2.3%	79%	1.8%	6.44	1.69
80	81%	1.3%	78%	1.8%	6.44	1.79
79	79%	1.9%	77%	1.9%	6.43	1.88
78	80%	1.8%	76%	1.9%	6.40	1.97
77	80%	1.9%	76%	2.0%	6.36	2.05
76	75%	3.4%	75%	2.0%	6.31	2.13
75	77%	1.6%	74%	2.0%	6.25	2.21
74	78%	2.0%	73%	2.1%	6.18	2.28
73	76%	2.7%	72%	2.1%	6.10	2.35
72	76%	2.7%	71%	2.2%	6.02	2.41
71	78%	2.6%	71%	2.2%	5.93	2.47
70	74%	4.2%	70%	2.3%	5.83	2.52
69	73%	3.0%	69%	2.3%	5.73	2.57
68	73%	4.8%	68%	2.3%	5.62	2.62
67	75%	2.5%	67%	2.4%	5.51	2.66
66	74%	2.1%	67%	2.4%	5.40	2.70
65	65%	4.7%	66%	2.5%	5.28	2.73
64	77%	3.4%	65%	2.5%	5.16	2.76
63	67%	6.0%	64%	2.6%	5.04	2.79
62	58%	7.1%	64%	2.6%	4.92	2.81
61	73%	1.0%	63%	2.7%	4.80	2.83

Table A10: Parameters of the Conditional Transition Probability, Φ, post-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	64%	3.6%	62%	2.8%	4.68	2.84
59	71%	4.4%	62%	2.8%	4.56	2.85
58	77%	0.9%	61%	2.9%	4.44	2.86
57	72%	2.0%	60%	2.9%	4.32	2.86
56	75%	1.8%	59%	3.0%	4.20	2.87
55	59%	5.5%	59%	3.0%	4.08	2.86
54	59%	6.9%	58%	3.1%	3.97	2.86
53	67%	3.1%	57%	3.2%	3.85	2.85
52	78%	0.8%	57%	3.2%	3.73	2.84
51	66%	1.3%	56%	3.3%	3.62	2.83
50	74%	2.3%	56%	3.4%	3.51	2.81
49	51%	8.9%	55%	3.4%	3.40	2.80
48	68%	3.7%	54%	3.5%	3.29	2.78
47	62%	3.9%	54%	3.6%	3.19	2.76
46	71%	9.8%	53%	3.7%	3.08	2.73
45	73%	1.4%	52%	3.7%	2.98	2.71
44	70%	1.0%	52%	3.8%	2.88	2.68
43	55%	11.7%	51%	3.9%	2.78	2.65
42	76%	1.0%	51%	4.0%	2.69	2.62
41	48%	8.8%	50%	4.0%	2.60	2.59
40	64%	3.5%	49%	4.1%	2.50	2.56
39	66%	1.2%	49%	4.2%	2.42	2.52
38	75%	0.9%	48%	4.3%	2.33	2.49
37	59%	0.5%	48%	4.4%	2.24	2.45
36	65%	12.4%	47%	4.5%	2.16	2.41
35	64%	1.1%	47%	4.6%	2.08	2.37
34	73%	0.2%	46%	4.7%	2.01	2.33
33	65%	11.4%	46%	4.7%	1.93	2.29
32	46%	21.2%	45%	4.8%	1.86	2.25
31	69%	1.7%	45%	4.9%	1.78	2.21
30	74%	1.5%	44%	5.0%	1.72	2.17
29	70%	0.3%	44%	5.1%	1.65	2.13
28	NA	NA	43%	5.3%	1.58	2.09
27	82%	0.0%	43%	5.4%	1.52	2.04
26	65%	8.7%	42%	5.5%	1.46	2.00
25	NA	NA	42%	5.6%	1.40	1.96
24	47%	13.1%	41%	5.7%	1.34	1.91
23	38%	12.1%	41%	5.8%	1.29	1.87
22	84%	1.4%	40%	5.9%	1.23	1.83
21	NA	NA	40%	6.0%	1.18	1.78

Table A10: Parameters of the Conditional Transition Probability, Φ, post-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	28%	16.1%	39%	6.2%	1.13	1.74
19	0%	0.0%	39%	6.3%	1.08	1.70
18	NA	NA	38%	6.4%	1.03	1.65
17	47%	0.0%	38%	6.6%	0.99	1.61
16	65%	7.9%	38%	6.7%	0.94	1.56
15	70%	0.9%	37%	6.8%	0.90	1.52
14	NA	NA	37%	7.0%	0.86	1.48
13	55%	15.4%	36%	7.1%	0.82	1.44
12	53%	14.6%	36%	7.3%	0.78	1.39
11	85%	0.0%	35%	7.4%	0.74	1.35
10	89%	0.0%	35%	7.5%	0.71	1.31
9	45%	0.0%	35%	7.7%	0.67	1.27
8	95%	0.0%	34%	7.9%	0.64	1.23
7	NA	NA	34%	8.0%	0.61	1.19
6	NA	NA	34%	8.2%	0.58	1.15
5	86%	0.0%	33%	8.3%	0.55	1.11
4	NA	NA	33%	8.5%	0.52	1.07
3	77%	2.3%	32%	8.7%	0.49	1.03
2	62%	19.4%	32%	8.9%	0.47	0.99
1	81%	0.7%	32%	9.0%	0.44	0.95
0	16%	8.8%	31%	9.2%	0.42	0.91
start-up	52%	9.5%			0.85	0.79

Table A11: Shutdown Probabilities, Θ, post-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	0.541%	0.002%
99	0	0.568%	0.002%
98	0	0.597%	0.002%
97	0	0.627%	0.002%
96	0	0.659%	0.002%
95	0	0.692%	0.002%
94	0	0.726%	0.002%
93	0	0.763%	0.002%
92	0	0.801%	0.003%
91	0	0.842%	0.003%
90	0	0.884%	0.003%
89	0	0.928%	0.003%
88	0	0.975%	0.003%
87	0.746%	1.024%	0.003%
86	0	1.076%	0.003%
85	1.613%	1.130%	0.004%
84	0	1.187%	0.004%
83	0	1.246%	0.004%
82	0	1.309%	0.004%
81	0	1.375%	0.004%
80	0	1.444%	0.005%
79	0	1.516%	0.005%
78	0	1.593%	0.005%
77	0	1.673%	0.005%
76	0	1.757%	0.005%
75	0	1.845%	0.006%
74	0	1.938%	0.006%
73	0	2.036%	0.006%
72	0	2.138%	0.007%
71	0	2.245%	0.007%
70	0	2.358%	0.007%
69	2.381%	2.477%	0.008%
68	0	2.602%	0.008%
67	0	2.732%	0.009%
66	0	2.870%	0.009%
65	0	3.014%	0.009%
64	0	3.166%	0.010%
63	0	3.325%	0.010%
62	0	3.492%	0.011%
61	0	3.668%	0.011%

Table A11: Shutdown Probabilities, Θ, post-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	0	3.852%	0.012%
59	0	4.046%	0.013%
58	0	4.250%	0.013%
57	0	4.463%	0.014%
56	0	4.688%	0.015%
55	0	4.924%	0.015%
54	0	5.171%	0.016%
53	0	5.431%	0.017%
52	0	5.704%	0.018%
51	0	5.991%	0.019%
50	0	6.293%	0.020%
49	0	6.609%	0.021%
48	0	6.941%	0.022%
47	0	7.290%	0.023%
46	0	7.657%	0.024%
45	0	8.042%	0.025%
44	0	8.447%	0.026%
43	0	8.871%	0.028%
42	0	9.318%	0.029%
41	0	9.786%	0.031%
40	0	10.278%	0.032%
39	0	10.795%	0.034%
38	0	11.338%	0.035%
37	0	11.908%	0.037%
36	0	12.507%	0.039%
35	0	13.136%	0.041%
34	0	13.797%	0.043%
33	0	14.491%	0.045%
32	0	15.220%	0.048%
31	0	15.985%	0.050%
30	0	16.789%	0.052%
29	0	17.633%	0.055%
28	0	18.520%	0.058%
27	0	19.452%	0.061%
26	0	20.430%	0.064%
25	0	21.457%	0.067%
24	0	22.537%	0.070%
23	0	23.670%	0.074%
22	0	24.860%	0.078%
21	0	26.111%	0.082%

Table A11: Shutdown Probabilities, Θ, post-2000

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	27.424%	0.086%
19	0	28.803%	0.090%
18	0	30.252%	0.095%
17	0	31.773%	0.099%
16	0	33.371%	0.104%
15	0	35.049%	0.109%
14	0	36.812%	0.115%
13	0	38.663%	0.121%
12	0	40.608%	0.127%
11	0	42.650%	0.133%
10	0	44.795%	0.140%
9	0	47.048%	0.147%
8	0	49.414%	0.154%
7	0	51.899%	0.162%
6	0	54.509%	0.170%
5	0	57.251%	0.179%
4	0	60.130%	0.188%
3	0	63.154%	0.197%
2	0	66.330%	0.207%
1	0	69.666%	0.218%
0	0	73.170%	0.229%
start-up	NA	NA	NA

Table A12: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, post-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1	54%	9.6%	54%	9.6%
2	62%	8.2%	62%	8.2%
3	68%	7.3%	68%	7.3%
4	71%	6.7%	71%	6.7%
5	74%	6.4%	74%	6.4%
6	76%	6.1%	77%	6.1%
7	78%	6.0%	78%	6.0%
8	80%	5.8%	80%	5.9%
9	81%	5.7%	81%	5.7%
10	82%	5.6%	82%	5.6%
11	83%	5.5%	83%	5.5%
12	84%	5.4%	84%	5.4%
13	85%	5.3%	85%	5.3%
14	85%	5.2%	86%	5.2%
15	86%	5.1%	86%	5.1%
16	87%	5.0%	87%	5.1%
17	87%	5.0%	87%	5.0%
18	87%	4.9%	88%	4.9%
19	88%	4.8%	88%	4.8%
20	88%	4.8%	88%	4.8%
21	88%	4.7%	89%	4.7%
22	89%	4.7%	89%	4.7%
23	89%	4.6%	89%	4.6%
24	89%	4.6%	89%	4.6%
25	89%	4.5%	89%	4.6%
26	89%	4.5%	90%	4.5%
27	89%	4.5%	90%	4.5%
28	89%	4.5%	90%	4.5%
29	90%	4.4%	90%	4.4%
30	90%	4.4%	90%	4.4%
31	90%	4.4%	90%	4.4%
32	90%	4.4%	90%	4.4%
33	90%	4.4%	90%	4.4%
34	90%	4.4%	90%	4.4%
35	90%	4.3%	90%	4.4%
36	90%	4.3%	90%	4.3%
37	90%	4.3%	90%	4.3%
38	90%	4.3%	90%	4.3%
39	90%	4.3%	90%	4.3%

Table A12: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, post-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40	90%	4.3%	90%	4.3%
41	90%	4.3%	90%	4.3%
42	90%	4.3%	90%	4.3%
43	90%	4.3%	91%	4.3%
44	90%	4.3%	91%	4.3%
45	90%	4.3%	91%	4.3%
46	90%	4.3%	91%	4.3%
47	90%	4.3%	91%	4.3%
48	90%	4.3%	91%	4.3%
49	90%	4.3%	91%	4.3%
50	90%	4.3%	91%	4.3%
51	90%	4.3%	91%	4.3%
52	90%	4.3%	91%	4.3%
53	90%	4.3%	91%	4.3%
54	90%	4.3%	91%	4.3%
55	90%	4.3%	91%	4.3%
56	90%	4.3%	91%	4.3%
57	90%	4.3%	91%	4.3%
58	90%	4.3%	91%	4.3%
59	90%	4.3%	91%	4.3%
60	90%	4.3%	91%	4.3%

Table A13: Parameters of the Conditional Transition Probability, Φ, OECD

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	85%	1.3%	93%	1.5%	3.16	0.25
99	83%	1.2%	92%	1.5%	3.47	0.30
98	82%	1.9%	91%	1.6%	3.76	0.37
97	84%	0.9%	90%	1.6%	4.01	0.43
96	82%	2.3%	90%	1.6%	4.23	0.49
95	83%	2.3%	89%	1.7%	4.43	0.56
94	83%	2.4%	88%	1.7%	4.61	0.63
93	86%	1.7%	87%	1.7%	4.76	0.70
92	86%	1.3%	86%	1.8%	4.89	0.77
91	86%	1.6%	86%	1.8%	5.01	0.84
90	86%	1.7%	85%	1.8%	5.10	0.91
89	85%	1.9%	84%	1.9%	5.18	0.98
88	84%	2.4%	83%	1.9%	5.25	1.05
87	83%	2.4%	83%	1.9%	5.30	1.11
86	83%	1.9%	82%	2.0%	5.33	1.18
85	81%	2.0%	81%	2.0%	5.36	1.24
84	80%	2.0%	80%	2.0%	5.37	1.31
83	82%	1.4%	80%	2.1%	5.38	1.37
82	79%	2.0%	79%	2.1%	5.37	1.43
81	80%	2.3%	78%	2.2%	5.35	1.48
80	79%	2.3%	78%	2.2%	5.33	1.54
79	78%	2.0%	77%	2.2%	5.30	1.59
78	77%	2.0%	76%	2.3%	5.26	1.64
77	77%	2.1%	76%	2.3%	5.22	1.69
76	76%	2.7%	75%	2.4%	5.17	1.73
75	73%	2.1%	74%	2.4%	5.12	1.78
74	74%	2.4%	74%	2.5%	5.06	1.82
73	73%	2.2%	73%	2.5%	4.99	1.85
72	75%	2.4%	72%	2.6%	4.93	1.89
71	74%	2.9%	72%	2.6%	4.86	1.92
70	73%	2.7%	71%	2.7%	4.78	1.95
69	69%	3.3%	70%	2.7%	4.71	1.98
68	69%	4.0%	70%	2.8%	4.63	2.01
67	71%	2.8%	69%	2.8%	4.55	2.03
66	73%	3.3%	69%	2.9%	4.47	2.05
65	67%	3.8%	68%	2.9%	4.39	2.07
64	69%	3.9%	67%	3.0%	4.30	2.09
63	67%	3.9%	67%	3.0%	4.22	2.11
62	64%	4.8%	66%	3.1%	4.13	2.12
61	68%	3.2%	66%	3.1%	4.05	2.13

Table A13: Parameters of the Conditional Transition Probability, Φ, OECD

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
60	65%	3.3%	65%	3.2%	3.96	2.14
59	67%	3.9%	64%	3.3%	3.87	2.14
58	68%	2.7%	64%	3.3%	3.79	2.15
57	68%	3.4%	63%	3.4%	3.70	2.15
56	68%	3.4%	63%	3.5%	3.61	2.15
55	61%	3.4%	62%	3.5%	3.53	2.15
54	63%	3.5%	62%	3.6%	3.44	2.15
53	61%	3.7%	61%	3.7%	3.36	2.15
52	69%	3.4%	60%	3.7%	3.28	2.14
51	61%	3.9%	60%	3.8%	3.19	2.13
50	66%	2.3%	59%	3.9%	3.11	2.13
49	56%	6.8%	59%	3.9%	3.03	2.12
48	61%	3.6%	58%	4.0%	2.95	2.11
47	66%	3.8%	58%	4.1%	2.87	2.09
46	64%	6.6%	57%	4.2%	2.79	2.08
45	56%	3.9%	57%	4.2%	2.71	2.06
44	63%	2.1%	56%	4.3%	2.64	2.05
43	61%	4.3%	56%	4.4%	2.56	2.03
42	61%	6.0%	55%	4.5%	2.49	2.01
41	61%	4.5%	55%	4.6%	2.42	1.99
40	52%	5.3%	54%	4.7%	2.35	1.97
39	56%	6.2%	54%	4.7%	2.28	1.95
38	62%	5.0%	53%	4.8%	2.21	1.93
37	57%	3.6%	53%	4.9%	2.14	1.91
36	57%	7.1%	52%	5.0%	2.08	1.89
35	57%	6.3%	52%	5.1%	2.01	1.86
34	70%	7.4%	51%	5.2%	1.95	1.84
33	57%	8.9%	51%	5.3%	1.89	1.81
32	61%	7.2%	51%	5.4%	1.83	1.79
31	74%	0.8%	50%	5.5%	1.77	1.76
30	64%	6.6%	50%	5.6%	1.71	1.74
29	75%	3.2%	49%	5.7%	1.66	1.71
28	72%	3.5%	49%	5.8%	1.60	1.68
27	61%	5.1%	48%	5.9%	1.55	1.65
26	50%	8.8%	48%	6.1%	1.50	1.62
25	52%	10.8%	48%	6.2%	1.45	1.60
24	51%	8.8%	47%	6.3%	1.40	1.57
23	53%	7.9%	47%	6.4%	1.35	1.54
22	73%	2.1%	46%	6.5%	1.30	1.51
21	61%	8.2%	46%	6.6%	1.25	1.48

Table A13: Parameters of the Conditional Transition Probability, Φ, OECD

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	39%	10.6%	45%	6.8%	1.21	1.45
19	50%	6.2%	45%	6.9%	1.17	1.42
18	51%	9.4%	45%	7.0%	1.12	1.39
17	37%	7.2%	44%	7.2%	1.08	1.36
16	62%	6.2%	44%	7.3%	1.04	1.33
15	66%	3.8%	43%	7.4%	1.00	1.30
14	43%	11.3%	43%	7.6%	0.96	1.27
13	41%	12.7%	43%	7.7%	0.93	1.24
12	53%	10.0%	42%	7.9%	0.89	1.21
11	60%	8.9%	42%	8.0%	0.86	1.18
10	65%	9.1%	42%	8.2%	0.82	1.15
9	52%	5.2%	41%	8.3%	0.79	1.12
8	69%	4.7%	41%	8.5%	0.76	1.09
7	69%	5.4%	40%	8.6%	0.72	1.07
6	70%	3.3%	40%	8.8%	0.69	1.04
5	64%	5.3%	40%	9.0%	0.66	1.01
4	46%	5.6%	39%	9.1%	0.64	0.98
3	58%	8.0%	39%	9.3%	0.61	0.95
2	58%	10.8%	39%	9.5%	0.58	0.92
1	62%	7.9%	38%	9.7%	0.56	0.89
0	19%	8.4%	38%	9.8%	0.53	0.86
start-up	53%	9.7%			0.83	0.73

Table A14: Shutdown Probabilities, Θ, OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	0.146%	0.001%
99	0	0.154%	0.001%
98	0	0.163%	0.001%
97	0	0.173%	0.001%
96	0	0.183%	0.001%
95	0	0.193%	0.001%
94	0	0.205%	0.001%
93	0	0.217%	0.001%
92	0	0.229%	0.001%
91	0	0.242%	0.001%
90	0	0.257%	0.002%
89	0	0.271%	0.002%
88	0	0.287%	0.002%
87	0	0.304%	0.002%
86	0	0.321%	0.002%
85	0.385%	0.340%	0.002%
84	0	0.360%	0.002%
83	0.380%	0.381%	0.002%
82	0	0.403%	0.002%
81	0	0.426%	0.002%
80	0	0.451%	0.003%
79	0	0.477%	0.003%
78	0	0.505%	0.003%
77	0	0.534%	0.003%
76	0.467%	0.565%	0.003%
75	0.437%	0.598%	0.003%
74	0	0.633%	0.004%
73	0	0.670%	0.004%
72	0	0.708%	0.004%
71	0	0.750%	0.004%
70	0	0.793%	0.005%
69	1.399%	0.839%	0.005%
68	0	0.888%	0.005%
67	0	0.939%	0.005%
66	0	0.994%	0.006%
65	0	1.052%	0.006%
64	0	1.113%	0.006%
63	0	1.177%	0.007%
62	0	1.246%	0.007%
61	0	1.318%	0.008%

Table A14: Shutdown Probabilities, Θ, OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	0	1.394%	0.008%
59	1.299%	1.475%	0.009%
58	0	1.561%	0.009%
57	0	1.652%	0.010%
56	0	1.747%	0.010%
55	0	1.849%	0.011%
54	0	1.956%	0.011%
53	0	2.070%	0.012%
52	0	2.190%	0.013%
51	0	2.317%	0.014%
50	0	2.452%	0.014%
49	0	2.594%	0.015%
48	0	2.744%	0.016%
47	0	2.904%	0.017%
46	0	3.072%	0.018%
45	0	3.251%	0.019%
44	0	3.439%	0.020%
43	0	3.639%	0.021%
42	0	3.850%	0.022%
41	0	4.074%	0.024%
40	0	4.310%	0.025%
39	0	4.561%	0.027%
38	0	4.825%	0.028%
37	0	5.105%	0.030%
36	0	5.402%	0.032%
35	0	5.715%	0.033%
34	0	6.047%	0.035%
33	0	6.398%	0.037%
32	0	6.770%	0.040%
31	0	7.163%	0.042%
30	0	7.578%	0.044%
29	0	8.018%	0.047%
28	0	8.484%	0.050%
27	0	8.976%	0.052%
26	0	9.498%	0.055%
25	0	10.049%	0.059%
24	0	10.632%	0.062%
23	0	11.249%	0.066%
22	0	11.903%	0.069%
21	0	12.594%	0.073%

Table A14: Shutdown Probabilities, Θ, OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	13.325%	0.078%
19	0	14.098%	0.082%
18	0	14.917%	0.087%
17	0	15.783%	0.092%
16	0	16.699%	0.097%
15	0	17.668%	0.103%
14	0	18.694%	0.109%
13	0	19.779%	0.115%
12	0	20.927%	0.122%
11	0	22.142%	0.129%
10	0	23.428%	0.137%
9	0	24.788%	0.145%
8	0	26.227%	0.153%
7	0	27.749%	0.162%
6	0	29.360%	0.171%
5	0	31.064%	0.181%
4	0	32.868%	0.192%
3	0	34.776%	0.203%
2	0	36.795%	0.215%
1	0	38.931%	0.227%
0	0	41.191%	0.240%
start-up	NA	NA	NA

Table A15: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, OECD

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1	54%	9.7%	54%	9.7%
2	64%	7.2%	64%	7.2%
3	70%	5.8%	70%	5.8%
4	73%	5.0%	73%	5.0%
5	75%	4.6%	75%	4.6%
6	76%	4.4%	76%	4.4%
7	76%	4.3%	77%	4.3%
8	77%	4.2%	77%	4.2%
9	77%	4.2%	77%	4.2%
10	77%	4.2%	77%	4.2%
11	77%	4.2%	78%	4.2%
12	77%	4.1%	78%	4.2%
13	78%	4.1%	78%	4.1%
14	78%	4.1%	78%	4.1%
15	78%	4.1%	78%	4.1%
16	78%	4.1%	78%	4.1%
17	78%	4.1%	78%	4.1%
18	78%	4.1%	78%	4.1%
19	78%	4.1%	78%	4.1%
20	78%	4.1%	78%	4.1%
21	78%	4.1%	78%	4.1%
22	78%	4.1%	78%	4.1%
23	78%	4.1%	78%	4.1%
24	78%	4.1%	78%	4.1%
25	78%	4.1%	78%	4.1%
26	78%	4.1%	78%	4.1%
27	78%	4.1%	78%	4.1%
28	78%	4.1%	78%	4.1%
29	77%	4.1%	78%	4.1%
30	77%	4.1%	78%	4.1%
31	77%	4.1%	78%	4.1%
32	77%	4.1%	78%	4.1%
33	77%	4.1%	78%	4.1%
34	77%	4.1%	78%	4.1%
35	77%	4.1%	78%	4.1%
36	77%	4.1%	78%	4.1%
37	77%	4.1%	78%	4.1%
38	77%	4.1%	78%	4.1%
39	77%	4.1%	78%	4.1%

Table A15: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, OECD

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40	77%	4.1%	78%	4.1%
41	77%	4.1%	78%	4.1%
42	77%	4.1%	78%	4.1%
43	77%	4.1%	78%	4.1%
44	77%	4.1%	78%	4.1%
45	77%	4.1%	78%	4.1%
46	77%	4.1%	78%	4.1%
47	77%	4.1%	78%	4.1%
48	77%	4.1%	78%	4.1%
49	77%	4.1%	78%	4.1%
50	77%	4.1%	78%	4.1%
51	77%	4.1%	78%	4.1%
52	77%	4.1%	78%	4.1%
53	77%	4.1%	78%	4.1%
54	77%	4.1%	78%	4.1%
55	77%	4.1%	78%	4.1%
56	77%	4.1%	78%	4.1%
57	77%	4.1%	78%	4.1%
58	77%	4.1%	78%	4.1%
59	77%	4.1%	78%	4.1%
60	77%	4.1%	78%	4.1%

Table A16: Parameters of the Conditional Transition Probability, Φ, non-OECD

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	85%	1.3%	90%	1.0%	7.06	0.76
99	83%	1.2%	90%	1.0%	7.45	0.87
98	82%	1.9%	89%	1.0%	7.80	0.98
97	84%	0.9%	88%	1.0%	8.12	1.10
96	82%	2.3%	87%	1.0%	8.41	1.22
95	83%	2.3%	87%	1.1%	8.67	1.34
94	83%	2.4%	86%	1.1%	8.91	1.47
93	86%	1.7%	85%	1.1%	9.11	1.59
92	86%	1.3%	84%	1.1%	9.30	1.72
91	86%	1.6%	84%	1.1%	9.46	1.84
90	86%	1.7%	83%	1.1%	9.59	1.97
89	85%	1.9%	82%	1.1%	9.71	2.09
88	84%	2.4%	82%	1.2%	9.81	2.22
87	83%	2.4%	81%	1.2%	9.89	2.34
86	83%	1.9%	80%	1.2%	9.96	2.46
85	81%	2.0%	80%	1.2%	10.01	2.58
84	80%	2.0%	79%	1.2%	10.04	2.70
83	82%	1.4%	78%	1.2%	10.06	2.81
82	79%	2.0%	78%	1.2%	10.07	2.92
81	80%	2.3%	77%	1.3%	10.06	3.03
80	79%	2.3%	76%	1.3%	10.05	3.14
79	78%	2.0%	76%	1.3%	10.02	3.24
78	77%	2.0%	75%	1.3%	9.98	3.34
77	77%	2.1%	74%	1.3%	9.94	3.44
76	76%	2.7%	74%	1.3%	9.88	3.54
75	73%	2.1%	73%	1.4%	9.82	3.63
74	74%	2.4%	72%	1.4%	9.75	3.72
73	73%	2.2%	72%	1.4%	9.67	3.80
72	75%	2.4%	71%	1.4%	9.59	3.88
71	74%	2.9%	71%	1.4%	9.50	3.96
70	73%	2.7%	70%	1.5%	9.41	4.04
69	69%	3.3%	69%	1.5%	9.31	4.11
68	69%	4.0%	69%	1.5%	9.21	4.18
67	71%	2.8%	68%	1.5%	9.11	4.24
66	73%	3.3%	68%	1.5%	9.00	4.31
65	67%	3.8%	67%	1.6%	8.88	4.36
64	69%	3.9%	66%	1.6%	8.77	4.42
63	67%	3.9%	66%	1.6%	8.65	4.47
62	64%	4.8%	65%	1.6%	8.53	4.52
61	68%	3.2%	65%	1.6%	8.41	4.57

Table A16: Parameters of the Conditional Transition Probability, Φ, non-OECD

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	65%	3.3%	64%	1.7%	8.28	4.61
59	67%	3.9%	64%	1.7%	8.16	4.65
58	68%	2.7%	63%	1.7%	8.03	4.68
57	68%	3.4%	63%	1.7%	7.91	4.71
56	68%	3.4%	62%	1.7%	7.78	4.74
55	61%	3.4%	62%	1.8%	7.65	4.77
54	63%	3.5%	61%	1.8%	7.52	4.80
53	61%	3.7%	61%	1.8%	7.39	4.82
52	69%	3.4%	60%	1.8%	7.26	4.83
51	61%	3.9%	60%	1.9%	7.13	4.85
50	66%	2.3%	59%	1.9%	7.00	4.86
49	56%	6.8%	59%	1.9%	6.87	4.87
48	61%	3.6%	58%	1.9%	6.75	4.88
47	66%	3.8%	58%	2.0%	6.62	4.89
46	64%	6.6%	57%	2.0%	6.49	4.89
45	56%	3.9%	57%	2.0%	6.37	4.89
44	63%	2.1%	56%	2.0%	6.24	4.89
43	61%	4.3%	56%	2.1%	6.12	4.89
42	61%	6.0%	55%	2.1%	5.99	4.88
41	61%	4.5%	55%	2.1%	5.87	4.87
40	52%	5.3%	54%	2.1%	5.75	4.86
39	56%	6.2%	54%	2.2%	5.63	4.85
38	62%	5.0%	53%	2.2%	5.51	4.84
37	57%	3.6%	53%	2.2%	5.40	4.82
36	57%	7.1%	52%	2.3%	5.28	4.80
35	57%	6.3%	52%	2.3%	5.17	4.78
34	70%	7.4%	51%	2.3%	5.06	4.76
33	57%	8.9%	51%	2.3%	4.95	4.74
32	61%	7.2%	51%	2.4%	4.84	4.72
31	74%	0.8%	50%	2.4%	4.73	4.69
30	64%	6.6%	50%	2.4%	4.62	4.66
29	75%	3.2%	49%	2.5%	4.52	4.64
28	72%	3.5%	49%	2.5%	4.41	4.61
27	61%	5.1%	49%	2.5%	4.31	4.58
26	50%	8.8%	48%	2.6%	4.21	4.54
25	52%	10.8%	48%	2.6%	4.11	4.51
24	51%	8.8%	47%	2.6%	4.02	4.48
23	53%	7.9%	47%	2.7%	3.92	4.44
22	73%	2.1%	46%	2.7%	3.83	4.41
21	61%	8.2%	46%	2.7%	3.74	4.37

Table A16: Parameters of the Conditional Transition Probability, Φ, non-OECD

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
20	39%	10.6%	46%	2.8%	3.65	4.33
19	50%	6.2%	45%	2.8%	3.56	4.29
18	51%	9.4%	45%	2.8%	3.47	4.25
17	37%	7.2%	45%	2.9%	3.39	4.21
16	62%	6.2%	44%	2.9%	3.30	4.17
15	66%	3.8%	44%	2.9%	3.22	4.13
14	43%	11.3%	43%	3.0%	3.14	4.09
13	41%	12.7%	43%	3.0%	3.06	4.05
12	53%	10.0%	43%	3.1%	2.98	4.01
11	60%	8.9%	42%	3.1%	2.91	3.96
10	65%	9.1%	42%	3.1%	2.83	3.92
9	52%	5.2%	42%	3.2%	2.76	3.87
8	69%	4.7%	41%	3.2%	2.69	3.83
7	69%	5.4%	41%	3.3%	2.62	3.78
6	70%	3.3%	41%	3.3%	2.55	3.74
5	64%	5.3%	40%	3.4%	2.48	3.69
4	46%	5.6%	40%	3.4%	2.42	3.65
3	58%	8.0%	40%	3.4%	2.35	3.60
2	58%	10.8%	39%	3.5%	2.29	3.55
1	62%	7.9%	39%	3.5%	2.23	3.51
0	19%	8.4%	39%	3.6%	2.17	3.46
start-up	53%	9.7%			0.83	0.73

Table A17: Shutdown Probabilities, Θ, non-OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
100	0	3.177%	0.198%
99	0	3.276%	0.204%
98	0	3.379%	0.211%
97	0	3.485%	0.217%
96	0	3.595%	0.224%
95	0	3.707%	0.231%
94	20.000%	3.824%	0.238%
93	0	3.944%	0.246%
92	0	4.067%	0.253%
91	0	4.195%	0.261%
90	0	4.326%	0.270%
89	0	4.462%	0.278%
88	0	4.602%	0.287%
87	3.333%	4.746%	0.296%
86	0	4.895%	0.305%
85	3.125%	5.049%	0.315%
84	0	5.207%	0.324%
83	0	5.371%	0.335%
82	0	5.539%	0.345%
81	0	5.713%	0.356%
80	0	5.892%	0.367%
79	0	6.077%	0.379%
78	0	6.267%	0.390%
77	0	6.464%	0.403%
76	0	6.667%	0.415%
75	0	6.876%	0.428%
74	0	7.092%	0.442%
73	0	7.314%	0.456%
72	0	7.544%	0.470%
71	0	7.780%	0.485%
70	0	8.024%	0.500%
69	0	8.276%	0.516%
68	0	8.536%	0.532%
67	4.167%	8.803%	0.548%
66	0	9.079%	0.566%
65	0	9.364%	0.583%
64	0	9.658%	0.602%
63	0	9.961%	0.621%
62	0	10.273%	0.640%
61	0	10.596%	0.660%

Table A17: Shutdown Probabilities, Θ, non-OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
60	5.882%	10.928%	0.681%
59	0	11.271%	0.702%
58	0	11.624%	0.724%
57	0	11.989%	0.747%
56	0	12.365%	0.770%
55	0	12.753%	0.795%
54	0	13.153%	0.819%
53	0	13.566%	0.845%
52	0	13.991%	0.872%
51	0	14.430%	0.899%
50	0	14.883%	0.927%
49	0	15.349%	0.956%
48	0	15.831%	0.986%
47	0	16.327%	1.017%
46	0	16.840%	1.049%
45	0	17.368%	1.082%
44	0	17.913%	1.116%
43	0	18.475%	1.151%
42	0	19.054%	1.187%
41	0	19.652%	1.224%
40	0	20.268%	1.263%
39	0	20.904%	1.302%
38	0	21.560%	1.343%
37	0	22.236%	1.385%
36	0	22.934%	1.429%
35	0	23.653%	1.474%
34	0	24.395%	1.520%
33	0	25.160%	1.567%
32	0	25.949%	1.617%
31	0	26.763%	1.667%
30	0	27.603%	1.720%
29	0	28.469%	1.774%
28	0	29.362%	1.829%
27	0	30.283%	1.887%
26	0	31.233%	1.946%
25	0	32.212%	2.007%
24	0	33.223%	2.070%
23	0	34.265%	2.135%
22	0	35.340%	2.202%
21	0	36.448%	2.271%

Table A17: Shutdown Probabilities, Θ, non-OECD

Load Factor in Year n	Sample Frequency	Fitted Frequency	Scaled, Fitted Frequency
20	0	37.592%	2.342%
19	0	38.771%	2.415%
18	0	39.987%	2.491%
17	0	41.241%	2.569%
16	0	42.535%	2.650%
15	0	43.869%	2.733%
14	0	45.245%	2.819%
13	0	46.665%	2.907%
12	0	48.128%	2.998%
11	0	49.638%	3.092%
10	0	51.195%	3.189%
9	0	52.801%	3.290%
8	0	54.457%	3.393%
7	0	56.166%	3.499%
6	100.000%	57.927%	3.609%
5	0	59.745%	3.722%
4	0	61.619%	3.839%
3	0	63.551%	3.959%
2	0	65.545%	4.083%
1	0	67.601%	4.212%
0	0	69.722%	4.344%
start-up	NA	NA	NA

Notes:

Sample moments correspond to the Transition Matrix shown in Table 4.

Fitted moment values are based on the regression results shown in Table 6. The regression fits the l

log variance. The fitted log values are then translated back into percentage levels.

Beta Distribution Parameters are calculated by the method of moments using these equations:

Mean = alpha / (alpha+beta),

Variance = (alpha*beta) / [(alpha+beta)^2 * (alpha+beta+1)].

Table A18: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, non-OECD

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1	54%	9.0%	54%	9.0%
2	63%	4.3%	64%	4.4%
3	67%	2.9%	68%	3.0%
4	68%	2.5%	70%	2.5%
5	69%	2.3%	71%	2.3%
6	69%	2.3%	72%	2.3%
7	69%	2.2%	72%	2.2%
8	69%	2.2%	72%	2.2%
9	69%	2.2%	72%	2.2%
10	68%	2.3%	73%	2.2%
11	68%	2.3%	73%	2.2%
12	68%	2.3%	73%	2.2%
13	68%	2.3%	73%	2.2%
14	67%	2.3%	73%	2.2%
15	67%	2.4%	73%	2.2%
16	67%	2.4%	73%	2.2%
17	66%	2.4%	73%	2.2%
18	66%	2.4%	73%	2.2%
19	65%	2.5%	73%	2.2%
20	65%	2.5%	73%	2.2%
21	65%	2.5%	73%	2.2%
22	64%	2.6%	73%	2.2%
23	64%	2.6%	73%	2.2%
24	64%	2.6%	73%	2.2%
25	64%	2.7%	73%	2.2%
26	63%	2.7%	73%	2.2%
27	63%	2.8%	73%	2.2%
28	63%	2.8%	73%	2.2%
29	62%	2.8%	73%	2.2%
30	62%	2.9%	73%	2.2%
31	62%	2.9%	73%	2.2%
32	61%	3.0%	73%	2.2%
33	61%	3.0%	73%	2.2%
34	61%	3.1%	73%	2.2%
35	60%	3.1%	73%	2.2%
36	60%	3.2%	73%	2.2%
37	60%	3.2%	73%	2.2%
38	59%	3.3%	73%	2.2%
39	59%	3.3%	73%	2.2%

Table A18: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, non-OECD

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40	59%	3.4%	73%	2.2%
41	58%	3.4%	73%	2.2%
42	58%	3.5%	73%	2.2%
43	58%	3.5%	73%	2.2%
44	58%	3.6%	73%	2.2%
45	57%	3.6%	73%	2.2%
46	57%	3.7%	73%	2.2%
47	57%	3.7%	73%	2.2%
48	56%	3.8%	73%	2.2%
49	56%	3.8%	73%	2.2%
50	56%	3.9%	73%	2.2%
51	56%	3.9%	73%	2.2%
52	55%	4.0%	73%	2.2%
53	55%	4.0%	73%	2.2%
54	55%	4.1%	73%	2.2%
55	54%	4.2%	73%	2.2%
56	54%	4.2%	73%	2.2%
57	54%	4.3%	73%	2.2%
58	54%	4.3%	73%	2.2%
59	53%	4.4%	73%	2.2%
60	53%	4.4%	73%	2.2%

Table A19: Parameters of the Conditional Transition Probability, Φ, US, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	82%	1.2%	85%	2.3%	3.74	0.64
99	81%	0.5%	85%	2.3%	3.83	0.69
98	83%	0.2%	84%	2.4%	3.90	0.73
97	77%	0.7%	84%	2.4%	3.97	0.78
96	73%	2.1%	83%	2.4%	4.03	0.82
95	74%	2.7%	82%	2.4%	4.08	0.87
94	70%	3.7%	82%	2.5%	4.13	0.92
93	75%	2.5%	81%	2.5%	4.17	0.96
92	79%	1.6%	81%	2.5%	4.21	1.01
91	77%	3.4%	80%	2.5%	4.24	1.05
90	76%	3.4%	80%	2.6%	4.27	1.10
89	84%	1.9%	79%	2.6%	4.29	1.14
88	76%	4.0%	78%	2.6%	4.31	1.18
87	73%	5.9%	78%	2.6%	4.32	1.22
86	79%	3.6%	77%	2.7%	4.33	1.27
85	77%	4.3%	77%	2.7%	4.33	1.31
84	77%	3.8%	76%	2.7%	4.33	1.35
83	84%	1.7%	76%	2.7%	4.33	1.39
82	76%	3.7%	75%	2.8%	4.33	1.43
81	77%	4.5%	75%	2.8%	4.32	1.46
80	75%	5.0%	74%	2.8%	4.31	1.50
79	74%	4.0%	74%	2.8%	4.29	1.54
78	77%	2.5%	73%	2.9%	4.28	1.57
77	80%	2.8%	73%	2.9%	4.26	1.61
76	75%	3.0%	72%	2.9%	4.24	1.64
75	71%	2.7%	72%	3.0%	4.21	1.67
74	69%	3.7%	71%	3.0%	4.19	1.70
73	72%	2.5%	71%	3.0%	4.16	1.73
72	75%	3.4%	70%	3.0%	4.13	1.76
71	73%	4.0%	70%	3.1%	4.10	1.79
70	70%	2.6%	69%	3.1%	4.07	1.82
69	65%	3.4%	69%	3.1%	4.03	1.84
68	67%	3.7%	68%	3.2%	4.00	1.87
67	67%	4.3%	68%	3.2%	3.96	1.89
66	69%	3.7%	67%	3.2%	3.92	1.91
65	65%	2.8%	67%	3.3%	3.88	1.94
64	65%	4.1%	66%	3.3%	3.84	1.96
63	65%	3.7%	66%	3.3%	3.80	1.98
62	64%	3.1%	65%	3.4%	3.76	2.00
61	68%	4.5%	65%	3.4%	3.72	2.01

Table A19: Parameters of the Conditional Transition Probability, Φ, US, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	66%	2.7%	64%	3.4%	3.68	2.03
59	68%	3.0%	64%	3.5%	3.63	2.05
58	69%	2.3%	64%	3.5%	3.59	2.06
57	56%	5.5%	63%	3.5%	3.54	2.07
56	65%	4.8%	63%	3.6%	3.50	2.09
55	59%	4.2%	62%	3.6%	3.45	2.10
54	65%	2.5%	62%	3.6%	3.41	2.11
53	61%	5.0%	61%	3.7%	3.36	2.12
52	64%	4.1%	61%	3.7%	3.32	2.13
51	59%	3.8%	60%	3.7%	3.27	2.14
50	61%	1.6%	60%	3.8%	3.22	2.15
49	59%	4.6%	60%	3.8%	3.18	2.15
48	56%	3.4%	59%	3.8%	3.13	2.16
47	69%	2.7%	59%	3.9%	3.08	2.16
46	67%	1.8%	58%	3.9%	3.04	2.17
45	62%	0.9%	58%	4.0%	2.99	2.17
44	66%	2.3%	58%	4.0%	2.95	2.17
43	60%	3.8%	57%	4.0%	2.90	2.17
42	63%	3.1%	57%	4.1%	2.85	2.18
41	50%	0.6%	56%	4.1%	2.81	2.18
40	47%	4.8%	56%	4.2%	2.76	2.17
39	53%	5.2%	56%	4.2%	2.72	2.17
38	58%	3.8%	55%	4.2%	2.67	2.17
37	50%	4.3%	55%	4.3%	2.63	2.17
36	46%	6.6%	54%	4.3%	2.58	2.17
35	46%	6.6%	54%	4.4%	2.54	2.16
34	70%	3.2%	54%	4.4%	2.50	2.16
33	43%	3.9%	53%	4.4%	2.45	2.15
32	67%	4.2%	53%	4.5%	2.41	2.15
31	71%	0.9%	53%	4.5%	2.37	2.14
30	66%	2.9%	52%	4.6%	2.32	2.13
29	58%	1.2%	52%	4.6%	2.28	2.12
28	78%	1.5%	51%	4.7%	2.24	2.12
27	49%	7.1%	51%	4.7%	2.20	2.11
26	40%	6.3%	51%	4.8%	2.16	2.10
25	47%	14.6%	50%	4.8%	2.12	2.09
24	49%	9.9%	50%	4.8%	2.08	2.08
23	58%	3.6%	50%	4.9%	2.04	2.07
22	72%	2.2%	49%	4.9%	2.00	2.06
21	33%	5.9%	49%	5.0%	1.96	2.05

Table A19: Parameters of the Conditional Transition Probability, Φ, US, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
20	47%	8.6%	49%	5.0%	1.92	2.03
19	68%	1.4%	48%	5.1%	1.89	2.02
18	42%	7.8%	48%	5.1%	1.85	2.01
17	41%	11.7%	48%	5.2%	1.81	2.00
16	52%	6.2%	47%	5.2%	1.78	1.98
15	63%	5.2%	47%	5.3%	1.74	1.97
14	26%	14.4%	47%	5.3%	1.70	1.95
13	40%	11.3%	46%	5.4%	1.67	1.94
12	90%	0.0%	46%	5.4%	1.64	1.92
11	51%	4.1%	46%	5.5%	1.60	1.91
10	50%	0.0%	45%	5.6%	1.57	1.89
9	32%	0.0%	45%	5.6%	1.54	1.88
8	48%	2.3%	45%	5.7%	1.50	1.86
7	45%	4.3%	44%	5.7%	1.47	1.85
6	70%	2.2%	44%	5.8%	1.44	1.83
5	69%	0.0%	44%	5.8%	1.41	1.81
4	46%	6.4%	43%	5.9%	1.38	1.80
3	54%	8.1%	43%	5.9%	1.35	1.78
2	56%	4.2%	43%	6.0%	1.32	1.76
1	57%	6.9%	43%	6.1%	1.29	1.74
0	30%	9.2%	42%	6.1%	1.26	1.73
start-up	NA	NA			NA	NA

Table A20: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, US, pre-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
1			54%	9.6%
2			64%	5.6%
3			68%	4.5%
4			69%	4.2%
5			70%	4.1%
6			70%	4.1%
7			70%	4.1%
8			71%	4.1%
9			71%	4.1%
10			71%	4.0%
11			71%	4.0%
12			71%	4.0%
13			71%	4.0%
14			71%	4.0%
15			71%	4.0%
16			71%	4.0%
17			71%	4.0%
18			71%	4.0%
19			71%	4.0%
20			71%	4.0%
21			71%	4.0%
22			71%	4.0%
23			71%	4.0%
24			71%	4.0%
25			71%	4.0%
26			71%	4.0%
27			71%	4.0%
28			71%	4.0%
29			71%	4.0%
30			71%	4.0%
31			71%	4.0%
32			71%	4.0%
33			71%	4.0%
34			71%	4.0%
35			71%	4.0%
36			71%	4.0%
37			71%	4.0%
38			71%	4.0%
39			71%	4.0%

Table A20: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, US, pre-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
40			71%	4.0%
41			71%	4.0%
42			71%	4.0%
43			71%	4.0%
44			71%	4.0%
45			71%	4.0%
46			71%	4.0%
47			71%	4.0%
48			71%	4.0%
49			71%	4.0%
50			71%	4.0%
51			71%	4.0%
52			71%	4.0%
53			71%	4.0%
54			71%	4.0%
55			71%	4.0%
56			71%	4.0%
57			71%	4.0%
58			71%	4.0%
59			71%	4.0%
60			71%	4.0%

Notes:

Unconditional values not calculated due to lack of any permanent shutdowns during the relevant period.

Distribution in Year 1 are based on start-up parameters for the OECD as a whole, i.e. from Table 13.

Table A21: Parameters of the Conditional Transition Probability, Φ, US, post-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
100	88%	0.5%	91%	0.6%	11.97	1.15
99	86%	1.5%	91%	0.6%	12.02	1.17
98	89%	0.4%	91%	0.6%	12.08	1.19
97	88%	0.4%	91%	0.6%	12.13	1.22
96	87%	0.8%	91%	0.6%	12.18	1.24
95	90%	0.7%	91%	0.6%	12.23	1.26
94	88%	1.2%	91%	0.6%	12.27	1.29
93	92%	0.6%	90%	0.6%	12.31	1.31
92	92%	0.5%	90%	0.6%	12.35	1.33
91	94%	0.5%	90%	0.6%	12.39	1.35
90	92%	0.5%	90%	0.6%	12.43	1.37
89	93%	1.2%	90%	0.6%	12.46	1.40
88	94%	0.5%	90%	0.6%	12.49	1.42
87	94%	0.5%	90%	0.6%	12.52	1.44
86	94%	0.3%	90%	0.6%	12.55	1.46
85	91%	0.7%	89%	0.6%	12.57	1.48
84	92%	0.7%	89%	0.6%	12.60	1.51
83	92%	0.6%	89%	0.6%	12.62	1.53
82	91%	0.7%	89%	0.6%	12.64	1.55
81	94%	0.3%	89%	0.6%	12.66	1.57
80	91%	0.9%	89%	0.6%	12.67	1.59
79	87%	1.0%	89%	0.7%	12.69	1.61
78	94%	0.2%	89%	0.7%	12.70	1.63
77	93%	0.2%	88%	0.7%	12.71	1.65
76	91%	0.3%	88%	0.7%	12.72	1.67
75	86%	0.5%	88%	0.7%	12.73	1.69
74	91%	1.0%	88%	0.7%	12.74	1.71
73	93%	0.7%	88%	0.7%	12.74	1.74
72	94%	0.2%	88%	0.7%	12.75	1.75
71	77%	12.1%	88%	0.7%	12.75	1.77
70	88%	1.1%	88%	0.7%	12.75	1.79
69	94%	0.2%	88%	0.7%	12.75	1.81
68	97%	0.2%	87%	0.7%	12.75	1.83
67	94%	0.1%	87%	0.7%	12.75	1.85
66	68%	6.5%	87%	0.7%	12.74	1.87
65	83%	0.0%	87%	0.7%	12.74	1.89
64	89%	1.1%	87%	0.7%	12.73	1.91
63	2%	0.0%	87%	0.7%	12.72	1.93
62	100%	0.0%	87%	0.7%	12.71	1.94
61	NA	NA	87%	0.7%	12.70	1.96

Table A21: Parameters of the Conditional Transition Probability, Φ, US, post-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
60	88%	1.6%	87%	0.7%	12.69	1.98
59	NA	NA	86%	0.8%	12.68	2.00
58	NA	NA	86%	0.8%	12.66	2.01
57	NA	NA	86%	0.8%	12.65	2.03
56	NA	NA	86%	0.8%	12.63	2.05
55	NA	NA	86%	0.8%	12.61	2.07
54	NA	NA	86%	0.8%	12.60	2.08
53	NA	NA	86%	0.8%	12.58	2.10
52	NA	NA	86%	0.8%	12.56	2.11
51	85%	0.0%	85%	0.8%	12.53	2.13
50	NA	NA	85%	0.8%	12.51	2.15
49	NA	NA	85%	0.8%	12.49	2.16
48	NA	NA	85%	0.8%	12.47	2.18
47	NA	NA	85%	0.8%	12.44	2.19
46	NA	NA	85%	0.8%	12.41	2.21
45	NA	NA	85%	0.8%	12.39	2.22
44	NA	NA	85%	0.8%	12.36	2.24
43	NA	NA	85%	0.8%	12.33	2.25
42	77%	0.0%	84%	0.8%	12.30	2.27
41	NA	NA	84%	0.8%	12.27	2.28
40	NA	NA	84%	0.9%	12.24	2.29
39	NA	NA	84%	0.9%	12.21	2.31
38	NA	NA	84%	0.9%	12.18	2.32
37	NA	NA	84%	0.9%	12.15	2.33
36	99%	0.0%	84%	0.9%	12.12	2.35
35	NA	NA	84%	0.9%	12.08	2.36
34	NA	NA	84%	0.9%	12.05	2.37
33	NA	NA	83%	0.9%	12.01	2.38
32	NA	NA	83%	0.9%	11.98	2.40
31	NA	NA	83%	0.9%	11.94	2.41
30	NA	NA	83%	0.9%	11.91	2.42
29	NA	NA	83%	0.9%	11.87	2.43
28	NA	NA	83%	0.9%	11.83	2.44
27	NA	NA	83%	0.9%	11.79	2.45
26	NA	NA	83%	0.9%	11.75	2.46
25	NA	NA	83%	0.9%	11.71	2.48
24	NA	NA	82%	1.0%	11.67	2.49
23	NA	NA	82%	1.0%	11.63	2.50
22	NA	NA	82%	1.0%	11.59	2.51
21	NA	NA	82%	1.0%	11.55	2.52

Table A21: Parameters of the Conditional Transition Probability, Φ, US, post-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
20	NA	NA	82%	1.0%	11.51	2.53
19	NA	NA	82%	1.0%	11.47	2.54
18	NA	NA	82%	1.0%	11.43	2.54
17	NA	NA	82%	1.0%	11.38	2.55
16	NA	NA	82%	1.0%	11.34	2.56
15	NA	NA	81%	1.0%	11.30	2.57
14	NA	NA	81%	1.0%	11.25	2.58
13	NA	NA	81%	1.0%	11.21	2.59
12	47%	22.1%	81%	1.0%	11.17	2.60
11	NA	NA	81%	1.0%	11.12	2.60
10	NA	NA	81%	1.1%	11.08	2.61
9	NA	NA	81%	1.1%	11.03	2.62
8	NA	NA	81%	1.1%	10.98	2.63
7	NA	NA	81%	1.1%	10.94	2.63
6	NA	NA	80%	1.1%	10.89	2.64
5	NA	NA	80%	1.1%	10.85	2.65
4	NA	NA	80%	1.1%	10.80	2.65
3	NA	NA	80%	1.1%	10.75	2.66
2	88%	0.0%	80%	1.1%	10.71	2.67
1	89%	0.0%	80%	1.1%	10.66	2.67
0	74%	0.0%	80%	1.1%	10.61	2.68
start-up	NA	NA			NA	NA

Table A22: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, US, post-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
1			54%	9.6%
2			86%	0.9%
3			90%	0.6%
4			91%	0.6%
5			91%	0.6%
6			91%	0.6%
7			91%	0.6%
8			91%	0.6%
9			91%	0.6%
10			91%	0.6%
11			91%	0.6%
12			91%	0.6%
13			91%	0.6%
14			91%	0.6%
15			91%	0.6%
16			91%	0.6%
17			91%	0.6%
18			91%	0.6%
19			91%	0.6%
20			91%	0.6%
21			91%	0.6%
22			91%	0.6%
23			91%	0.6%
24			91%	0.6%
25			91%	0.6%
26			91%	0.6%
27			91%	0.6%
28			91%	0.6%
29			91%	0.6%
30			91%	0.6%
31			91%	0.6%
32			91%	0.6%
33			91%	0.6%
34			91%	0.6%
35			91%	0.6%
36			91%	0.6%
37			91%	0.6%
38			91%	0.6%
39			91%	0.6%

Table A22: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, US, post-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
40			91%	0.6%
41			91%	0.6%
42			91%	0.6%
43			91%	0.6%
44			91%	0.6%
45			91%	0.6%
46			91%	0.6%
47			91%	0.6%
48			91%	0.6%
49			91%	0.6%
50			91%	0.6%
51			91%	0.6%
52			91%	0.6%
53			91%	0.6%
54			91%	0.6%
55			91%	0.6%
56			91%	0.6%
57			91%	0.6%
58			91%	0.6%
59			91%	0.6%
60			91%	0.6%

Notes:

Unconditional values not calculated due to lack of any permanent shutdowns during the relevant period.

Distribution in Year 1 are based on start-up parameters for the OECD as a whole, i.e. from Table 13.

Table A23: Parameters of the Conditional Transition Probability, Φ, Japan, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	77%	1.4%	83%	1.1%	10.06	2.03
99	80%	0.4%	83%	1.1%	10.03	2.09
98	70%	0.8%	82%	1.1%	9.99	2.15
97	71%	1.1%	82%	1.1%	9.94	2.21
96	68%	2.5%	81%	1.2%	9.88	2.26
95	73%	0.3%	81%	1.2%	9.82	2.31
94	76%	1.3%	80%	1.2%	9.75	2.37
93	77%	0.3%	80%	1.2%	9.67	2.41
92	74%	0.5%	80%	1.2%	9.59	2.46
91	75%	0.5%	79%	1.3%	9.50	2.51
90	68%	0.0%	79%	1.3%	9.41	2.55
89	71%	6.7%	78%	1.3%	9.31	2.59
88	80%	0.7%	78%	1.3%	9.21	2.63
87	74%	2.2%	77%	1.4%	9.10	2.66
86	78%	0.2%	77%	1.4%	8.99	2.69
85	69%	1.4%	77%	1.4%	8.88	2.72
84	74%	2.9%	76%	1.5%	8.76	2.75
83	73%	1.6%	76%	1.5%	8.64	2.78
82	80%	1.0%	75%	1.5%	8.52	2.81
81	81%	1.2%	75%	1.5%	8.40	2.83
80	79%	1.2%	74%	1.6%	8.28	2.85
79	81%	1.3%	74%	1.6%	8.15	2.87
78	79%	1.4%	74%	1.6%	8.03	2.88
77	79%	4.0%	73%	1.7%	7.90	2.90
76	83%	1.6%	73%	1.7%	7.77	2.91
75	73%	3.7%	72%	1.7%	7.64	2.92
74	77%	3.3%	72%	1.8%	7.51	2.93
73	70%	3.1%	72%	1.8%	7.38	2.94
72	70%	3.2%	71%	1.8%	7.25	2.94
71	77%	1.8%	71%	1.9%	7.12	2.95
70	76%	1.3%	70%	1.9%	7.00	2.95
69	73%	3.6%	70%	1.9%	6.87	2.95
68	66%	3.0%	70%	2.0%	6.74	2.95
67	73%	2.5%	69%	2.0%	6.61	2.95
66	76%	2.1%	69%	2.1%	6.48	2.94
65	76%	2.8%	68%	2.1%	6.36	2.94
64	70%	4.9%	68%	2.1%	6.23	2.93
63	68%	2.9%	68%	2.2%	6.11	2.92
62	64%	8.5%	67%	2.2%	5.98	2.91
61	66%	3.9%	67%	2.3%	5.86	2.90

Table A23: Parameters of the Conditional Transition Probability, Φ, Japan, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
60	68%	3.3%	67%	2.3%	5.74	2.89
59	61%	5.4%	66%	2.4%	5.62	2.88
58	63%	3.0%	66%	2.4%	5.50	2.86
57	71%	0.6%	65%	2.5%	5.38	2.85
56	75%	0.4%	65%	2.5%	5.27	2.83
55	57%	1.4%	65%	2.5%	5.15	2.82
54	65%	2.6%	64%	2.6%	5.04	2.80
53	66%	0.0%	64%	2.6%	4.93	2.78
52	91%	0.8%	64%	2.7%	4.82	2.76
51	75%	1.9%	63%	2.8%	4.71	2.74
50	62%	2.3%	63%	2.8%	4.60	2.72
49	50%	7.9%	63%	2.9%	4.49	2.69
48	64%	0.4%	62%	2.9%	4.39	2.67
47	62%	2.2%	62%	3.0%	4.29	2.65
46	42%	7.1%	61%	3.0%	4.19	2.62
45	47%	0.0%	61%	3.1%	4.09	2.60
44	55%	2.4%	61%	3.2%	3.99	2.57
43	57%	0.6%	60%	3.2%	3.89	2.55
42	2%	0.0%	60%	3.3%	3.80	2.52
41	65%	0.7%	60%	3.3%	3.70	2.49
40	33%	5.6%	59%	3.4%	3.61	2.46
39	63%	5.2%	59%	3.5%	3.52	2.44
38	65%	0.0%	59%	3.5%	3.44	2.41
37	53%	0.9%	58%	3.6%	3.35	2.38
36	62%	2.2%	58%	3.7%	3.26	2.35
35	84%	1.5%	58%	3.8%	3.18	2.32
34	97%	0.0%	57%	3.8%	3.10	2.29
33	61%	9.6%	57%	3.9%	3.02	2.26
32	56%	9.2%	57%	4.0%	2.94	2.23
31	NA	NA	57%	4.1%	2.86	2.20
30	84%	1.8%	56%	4.1%	2.79	2.17
29	95%	0.0%	56%	4.2%	2.71	2.14
28	71%	1.0%	56%	4.3%	2.64	2.11
27	55%	0.0%	55%	4.4%	2.57	2.08
26	NA	NA	55%	4.5%	2.50	2.05
25	33%	0.0%	55%	4.6%	2.43	2.01
24	67%	5.2%	54%	4.6%	2.36	1.98
23	72%	7.8%	54%	4.7%	2.30	1.95
22	54%	0.0%	54%	4.8%	2.23	1.92
21	73%	0.0%	53%	4.9%	2.17	1.89

Table A23: Parameters of the Conditional Transition Probability, Φ, Japan, pre-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
20	NA	NA	53%	5.0%	2.11	1.86
19	NA	NA	53%	5.1%	2.05	1.83
18	91%	0.6%	53%	5.2%	1.99	1.79
17	NA	NA	52%	5.3%	1.93	1.76
16	NA	NA	52%	5.4%	1.87	1.73
15	96%	0.0%	52%	5.5%	1.82	1.70
14	NA	NA	51%	5.6%	1.76	1.67
13	46%	21.1%	51%	5.7%	1.71	1.64
12	NA	NA	51%	5.9%	1.66	1.61
11	NA	NA	51%	6.0%	1.61	1.58
10	50%	24.5%	50%	6.1%	1.56	1.55
9	72%	1.0%	50%	6.2%	1.51	1.52
8	64%	6.0%	50%	6.3%	1.47	1.49
7	92%	0.0%	49%	6.5%	1.42	1.45
6	83%	2.3%	49%	6.6%	1.38	1.42
5	54%	2.0%	49%	6.7%	1.33	1.39
4	20%	2.6%	49%	6.8%	1.29	1.36
3	41%	0.0%	48%	7.0%	1.25	1.34
2	NA	NA	48%	7.1%	1.21	1.31
1	58%	13.6%	48%	7.2%	1.17	1.28
0	27%	7.3%	48%	7.4%	1.13	1.25
start-up	NA	NA			NA	NA

Table A24: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Japan, pre-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
1			54%	9.6%
2			66%	4.3%
3			70%	2.9%
4			71%	2.5%
5			72%	2.3%
6			72%	2.3%
7			72%	2.3%
8			72%	2.3%
9			72%	2.3%
10			72%	2.3%
11			72%	2.3%
12			72%	2.3%
13			72%	2.3%
14			72%	2.3%
15			72%	2.3%
16			72%	2.3%
17			72%	2.3%
18			72%	2.3%
19			72%	2.3%
20			72%	2.3%
21			72%	2.3%
22			72%	2.3%
23			72%	2.3%
24			72%	2.3%
25			72%	2.3%
26			72%	2.3%
27			72%	2.3%
28			72%	2.3%
29			72%	2.3%
30			72%	2.3%
31			72%	2.3%
32			72%	2.3%
33			72%	2.3%
34			72%	2.3%
35			72%	2.3%
36			72%	2.3%
37			72%	2.3%
38			72%	2.3%
39			72%	2.3%

Table A24: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Japan, pre-2000

Year of Operation	Unconditional		Conditional on Operation	
	Mean	Var	Mean	Var
40			72%	2.3%
41			72%	2.3%
42			72%	2.3%
43			72%	2.3%
44			72%	2.3%
45			72%	2.3%
46			72%	2.3%
47			72%	2.3%
48			72%	2.3%
49			72%	2.3%
50			72%	2.3%
51			72%	2.3%
52			72%	2.3%
53			72%	2.3%
54			72%	2.3%
55			72%	2.3%
56			72%	2.3%
57			72%	2.3%
58			72%	2.3%
59			72%	2.3%
60			72%	2.3%

Notes:

Unconditional values not calculated due to lack of any permanent shutdowns during the relevant period.

Distribution in Year 1 are based on start-up parameters for the OECD as a whole, i.e. from Table 13.

Table A25: Parameters of the Conditional Transition Probability, Φ, Japan, post-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
100	70%	3.3%	86%	2.3%	3.58	0.57
99	74%	2.9%	85%	2.3%	3.71	0.64
98	57%	5.8%	85%	2.4%	3.83	0.70
97	87%	0.0%	84%	2.4%	3.94	0.76
96	62%	7.0%	83%	2.4%	4.04	0.83
95	67%	2.2%	82%	2.4%	4.12	0.89
94	69%	4.4%	81%	2.5%	4.19	0.95
93	75%	0.5%	81%	2.5%	4.26	1.02
92	74%	3.1%	80%	2.5%	4.31	1.08
91	84%	0.5%	79%	2.5%	4.36	1.14
90	78%	0.1%	78%	2.6%	4.40	1.21
89	72%	5.5%	78%	2.6%	4.43	1.27
88	86%	0.8%	77%	2.6%	4.45	1.33
87	74%	5.1%	76%	2.6%	4.47	1.39
86	87%	0.7%	76%	2.7%	4.47	1.45
85	83%	1.3%	75%	2.7%	4.48	1.50
84	81%	1.9%	74%	2.7%	4.48	1.56
83	82%	3.4%	73%	2.8%	4.47	1.61
82	80%	0.8%	73%	2.8%	4.46	1.67
81	71%	8.6%	72%	2.8%	4.44	1.72
80	83%	1.3%	71%	2.8%	4.42	1.77
79	77%	2.5%	71%	2.9%	4.40	1.82
78	80%	2.5%	70%	2.9%	4.37	1.86
77	79%	5.9%	69%	2.9%	4.34	1.91
76	63%	8.2%	69%	3.0%	4.31	1.95
75	74%	3.3%	68%	3.0%	4.27	2.00
74	76%	3.0%	68%	3.0%	4.23	2.04
73	73%	5.8%	67%	3.0%	4.19	2.07
72	59%	6.7%	66%	3.1%	4.14	2.11
71	79%	1.7%	66%	3.1%	4.10	2.15
70	59%	8.9%	65%	3.1%	4.05	2.18
69	74%	4.5%	64%	3.2%	4.00	2.21
68	61%	11.5%	64%	3.2%	3.95	2.24
67	60%	4.9%	63%	3.2%	3.90	2.27
66	80%	1.4%	63%	3.3%	3.85	2.29
65	52%	8.8%	62%	3.3%	3.79	2.32
64	72%	12.3%	61%	3.3%	3.74	2.34
63	56%	16.9%	61%	3.4%	3.68	2.36
62	33%	8.0%	60%	3.4%	3.62	2.38
61	64%	0.2%	60%	3.5%	3.57	2.40

Table A25: Parameters of the Conditional Transition Probability, Φ, Japan, post-2000

Load Factor in Year n	Sample Moments		Fitted Moments		Implied Beta Distribution	
	Mean	Var	Mean	Var	Alpha	Beta
60	65%	0.9%	59%	3.5%	3.51	2.42
59	69%	10.2%	59%	3.5%	3.45	2.43
58	90%	0.3%	58%	3.6%	3.39	2.45
57	61%	0.0%	58%	3.6%	3.33	2.46
56	81%	0.6%	57%	3.6%	3.27	2.47
55	21%	4.2%	56%	3.7%	3.22	2.48
54	33%	12.3%	56%	3.7%	3.16	2.49
53	37%	0.0%	55%	3.7%	3.10	2.49
52	NA	NA	55%	3.8%	3.04	2.50
51	66%	3.2%	54%	3.8%	2.98	2.50
50	86%	0.6%	54%	3.9%	2.93	2.50
49	35%	11.6%	53%	3.9%	2.87	2.50
48	82%	0.4%	53%	3.9%	2.81	2.50
47	88%	0.0%	52%	4.0%	2.75	2.50
46	93%	1.1%	52%	4.0%	2.70	2.50
45	NA	NA	51%	4.1%	2.64	2.50
44	60%	0.0%	51%	4.1%	2.59	2.49
43	0%	0.0%	50%	4.2%	2.53	2.48
42	76%	0.3%	50%	4.2%	2.48	2.48
41	48%	11.8%	50%	4.2%	2.42	2.47
40	57%	6.0%	49%	4.3%	2.37	2.46
39	NA	NA	49%	4.3%	2.32	2.45
38	75%	0.0%	48%	4.4%	2.27	2.44
37	58%	0.0%	48%	4.4%	2.22	2.43
36	NA	NA	47%	4.5%	2.16	2.42
35	63%	1.8%	47%	4.5%	2.11	2.40
34	76%	0.1%	46%	4.6%	2.07	2.39
33	49%	12.5%	46%	4.6%	2.02	2.37
32	46%	21.2%	46%	4.7%	1.97	2.36
31	82%	0.0%	45%	4.7%	1.92	2.34
30	69%	1.2%	45%	4.8%	1.88	2.33
29	65%	0.0%	44%	4.8%	1.83	2.31
28	NA	NA	44%	4.8%	1.79	2.29
27	NA	NA	43%	4.9%	1.74	2.27
26	35%	0.0%	43%	5.0%	1.70	2.25
25	NA	NA	43%	5.0%	1.66	2.23
24	71%	2.9%	42%	5.1%	1.62	2.21
23	84%	0.0%	42%	5.1%	1.57	2.19
22	84%	1.4%	41%	5.2%	1.53	2.17
21	NA	NA	41%	5.2%	1.49	2.15

Table A25: Parameters of the Conditional Transition Probability, Φ, Japan, post-2000

Load Factor in Year n	Sample Moments Mean	Sample Moments Var	Fitted Moments Mean	Fitted Moments Var	Implied Beta Distribution Alpha	Implied Beta Distribution Beta
20	0%	0.0%	41%	5.3%	1.46	2.13
19	0%	0.0%	40%	5.3%	1.42	2.10
18	NA	NA	40%	5.4%	1.38	2.08
17	NA	NA	40%	5.4%	1.34	2.06
16	83%	3.1%	39%	5.5%	1.31	2.03
15	68%	1.1%	39%	5.5%	1.27	2.01
14	NA	NA	38%	5.6%	1.24	1.98
13	0%	0.0%	38%	5.7%	1.21	1.96
12	51%	13.0%	38%	5.7%	1.17	1.94
11	85%	0.0%	37%	5.8%	1.14	1.91
10	89%	0.0%	37%	5.8%	1.11	1.89
9	NA	NA	37%	5.9%	1.08	1.86
8	NA	NA	36%	6.0%	1.05	1.83
7	NA	NA	36%	6.0%	1.02	1.81
6	NA	NA	36%	6.1%	0.99	1.78
5	86%	0.0%	35%	6.1%	0.96	1.76
4	NA	NA	35%	6.2%	0.93	1.73
3	92%	0.0%	35%	6.3%	0.90	1.70
2	98%	0.0%	34%	6.3%	0.88	1.68
1	72%	0.0%	34%	6.4%	0.85	1.65
0	21%	8.4%	34%	6.5%	0.83	1.63
start-up	NA	NA			NA	NA

Table A26: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Japan, post-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
1			54%	9.6%
2			59%	6.6%
3			61%	5.6%
4			62%	5.3%
5			62%	5.1%
6			62%	5.1%
7			62%	5.1%
8			62%	5.1%
9			62%	5.1%
10			62%	5.1%
11			62%	5.1%
12			62%	5.1%
13			62%	5.1%
14			62%	5.1%
15			62%	5.1%
16			62%	5.1%
17			62%	5.1%
18			62%	5.1%
19			62%	5.1%
20			62%	5.1%
21			62%	5.1%
22			62%	5.1%
23			62%	5.1%
24			62%	5.1%
25			62%	5.1%
26			62%	5.1%
27			62%	5.1%
28			62%	5.1%
29			62%	5.1%
30			62%	5.1%
31			62%	5.1%
32			62%	5.1%
33			62%	5.1%
34			62%	5.1%
35			62%	5.1%
36			62%	5.1%
37			62%	5.1%
38			62%	5.1%
39			62%	5.1%

Table A26: Distribution Moments for the Load Factor, Unconditional and Conditional on Continuing Operation, From P, Japan, post-2000

Year of Operation	Unconditional Mean	Unconditional Var	Conditional on Operation Mean	Conditional on Operation Var
40			62%	5.1%
41			62%	5.1%
42			62%	5.1%
43			62%	5.1%
44			62%	5.1%
45			62%	5.1%
46			62%	5.1%
47			62%	5.1%
48			62%	5.1%
49			62%	5.1%
50			62%	5.1%
51			62%	5.1%
52			62%	5.1%
53			62%	5.1%
54			62%	5.1%
55			62%	5.1%
56			62%	5.1%
57			62%	5.1%
58			62%	5.1%
59			62%	5.1%
60			62%	5.1%

Notes:

Unconditional values not calculated due to lack of any permanent shutdowns during the relevant period.

Distribution in Year 1 are based on start-up parameters for the OECD as a whole, i.e. from Table 13.