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# THE RELATIONSHIP BETWEEN THE VOLUME OF PREVENTATIVE PROCEDURES PERFORMED AND MEDICARE FEES

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Submitted to the Economics Faculty
in partial fulfillment of the requirements for the degree of
Bachelor Art in Economics

December 2011

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**Abstract**

*Prior research suggests that physicians respond to fee changes. Existing literature acknowledges physicians' demand inducement can resemble profit maximization or target-income behavior. This paper examines the relationship between the volume of five preventative services provided to Medicare Part B beneficiaries and their resource-based relative value scale reimbursement rates. This paper adds to previous research by analyzing services, by county, that have not yet been empirically tested.*

*The model decomposes the reimbursement rate into its four components to pay special attention to the relationship between each input and volume. The results from fixed-effects panel estimation demonstrate a negative relationship between volume and price. In respect to my research, the physicians' volume response to fee changes supports target-income theory.*

JEL classifications: I110, I130, I180

Keywords: volume responses, Medicare, RBRVS, physician incentives, over testing,

preventative care

# Table of Contents

## I. Background

Medicare is the leading program for providing health insurance to the elderly, and as the percentage of the population that is over 65 continues to increase along with rising medical costs, financing this program has become a growing concern. Recently, most of the increasing costs to the program have not been due to the increasing number of beneficiaries or greater incident of disease but due to increasing volumes of the services provided to beneficiaries (MedPAC 2008a).

Prior to 1992 the payment rates for physicians for treating Medicare beneficiaries was determined by the "customary, prevailing, and reasonable charge" (CPR). This system was criticized for inflating and misrepresenting fees. Economist William Hsiao, created the resource-based relative value scale (RBRVS) as an alternative system for determining reimbursements. This system compensates a physician based on the cost of the resources used to perform a given service. RBRVS was implemented by the federal government in 1992 as the scheme to determine all Medicare allowable payments.

Since its implementation, economists and health care providers have criticized the structure of the scheme. The calculation of inputs to determine price has been seen as an inefficient measure of value and an interruption of free-market price setting (Wedig 1993). Perverse incentives have been observed, including an increase of students entering specialties because of higher reimbursement rates leading a decrease in primary care (Hauer et al.2008). The current system reimburses providers solely on the quantity of the procedures they perform rather than the quality. Physicians may be incentivized to increase the volumes of the procedures supplied leading to overprovision and higher health care costs (Hennig-Schmidt et al. 2011). After the first ten years of RBRVS the relative value unit (RVU) per beneficiary grew by 50% (Maxwell 2007). Understanding physicians' volume responses to changes in fees is necessary

since Medicare uses the fee schedule as one of its only instruments to control volume (Hadley et al. 2009).

In 2007, the Congressional Budget Office conducted an analysis to identify the factors leading to growth in Medicare spending for physician services. This model decomposes the final reimbursement rate into the four resource inputs in order to examine how changes in each component effect the quantity of the service provided. They find increases in Medicare spending to be attributed to changes in the quantity of physicians' services due to physician and beneficiaries' response to changes in payment rates (CBO 2007). The Health Care Financing Administration attempts to control for this "volume-offset" by including an additional calculation in the fee schedule (Yip 1998). There have been continued efforts to understand the reasons behind the growth in volume of Medicare services.

The two main theories to explain physicians' incentives behind demand inducement are profit-maximization and target-income behavior (McGuire and Pauly 1991). Economic theory would explain an increase in services provided in response to reductions in the reimbursement rates, when physicians engage in volume-offsetting behavior. Economic theory also acknowledges the physician as a profit-maximizing agent that will decrease volume as fees decrease. The objective of this analysis is to determine which of the

## II. Literature Review

### A. The Resource Based Relative Value System Criticism

Rice (1983) uses a natural experiment to analyze changes in Medicare reimbursement rates and the extent to which physicians induce demand for services before the implementation of RBRVS. The data is from Medicare claims for physicians in Colorado between 1976 and

1978. He concludes there is a positive relationship between higher reimbursements and quantities of those services and tests.

Baumgardner (1992) examines the ability of RBRVS to represent efficient market prices. He uses theoretical models to determine that RBRVS will be more efficient than the old CPR system. However, one of the shortcomings is in the method for how "work," a component of the relative value formula, is determined. He concludes RBRVS to be more efficient than CPR, but not a recreation of efficient market prices. Cooper and Kramer (2008) demonstrate that RBRVS's assumption of an equal profit margin is inappropriate and inaccurate. They find costs to be misrepresented despite the complexity of the system.

Wedig (1993) develops a theory of optimal pricing for the relative value scale and finds the current system of basing prices on physicians' costs alone is not optimal. An interesting finding within the model of demand inducement reveals Ramsey rather than cost-based pricing would reduce deadweight loss of oversupply. Thornton and Esposto (2003) use an empirical model which includes 80 annual observations across 8 specialties 1988-1998 to study the impact of economic factors in choice of medical specialty which has seen a decline after the implementation of RBRVS for Medicare. Their results show medical residents react to economic incentive and urge health care policy to align the proper incentives necessary for physicians to want to enter into primary care.

Gillis and Lee (1997) examine physicians' incentives to take on new patients when Medicare reimbursement rates change. They use a two-period, two-payer model with data from the U.S. Department of Health and Human Services between 1991 and 1993. They find that

physicians respond to changes in the Medicare reimbursement rates and the extent varies by specialty.

Lucci et al. (2004) analyzes Medicare reimbursements for breast cancer operations, specifically. They studied 240 patients in 3 different surgical treatments, across different geographic regions. Their results indicate show a negative relationship between Medicare reimbursements and outcomes. The current system has perverse incentives of financially rewarding more invasive and higher-morbidity procedures rather than less invasive options.

Hauer et al. (2008) analyze the shortage of Internal Medicine physicians. This is a perverse incentive of RBRVS that threatens health care efficiency. They utilize data of 1177 medical students, from a cross-sectional survey in 2007 to analyze medical students' decisions to enter the field of internal medicine. They conduct a logistic regression and conclude that financial incentives play a major role in students' career decisions. O'Shea (2008) analyzes the failures of cost containment under the current fee schedule. He reports the current system is adversely affecting the quality of care due to misaligned incentives, an inaccurate sustainable growth rate (SGR) and physicians who are not reimbursed fairly. Failure to reform the current system will result in high expenses and threaten access to care.

Hennig-Schmidt et al. (2011) creates an experiment to test the empirical findings in health economics for fee-for-service versus capitation. Their results indicate a greater quantity of testing and services when physicians use a fee-for service system. Also, observing over-provision of healthcare under fee-for-service, under-provision under capitation.

**B. Payment Rates and Physicians' Provision of Services**

McGuire and Pauly (1991) develop a theoretical model of physician behavior to measure the extent to which physicians respond to lower payment rates with demand inducement. This model presents physicians influencing demand for their services to replace losses in income considering profit maximization and target income behavior. The physician, whose goal is profit-maximization, will decrease the volume of the service that has been reduced. The alternative would be a physician that sets a target income which they will maintain by engaging in "volume-offsetting" behavior when fees are reduced. The theory behind physicians' financial incentives does acknowledge that the increase or decrease in the quantity of a service provided to Medicare patients depends on whether the "income" or "substitution" effect dominates. The incentive to increase the volume of that service or substitute for a similar one is dependent on the elasticity of the treatment and the nature of the specialty.

Nguyen (1996) analyzes the volume increases as an offset of price controls in health spending. He focuses on the fee reductions from the Omnibus Budget Reconciliation Act of 1989 (OBRA89) by using data from the Medicare program between 1989 and 1990. He concludes that physicians increased the volumes of services that experienced fee reductions. For every 10% reduction, physicians would respond with by increasing the volume of these services by 3.7%. Bradford and Martin (1995) find through an empirical analysis that physician induced demand is not statistically significant despite the findings of similar research. They use a Semi Log Model to conclude there is neither evidence to support nor refute the relationship between increased reimbursement and physician induced demand

Yip (1998) uses a first difference model to analyze physician response to changes in Medicare prices. She focuses on the income effect following the McGuire and Pauly model. Results support the hypothesis that physicians increase supply in Medicare when they experience a decrease in income from price regulation.

Mitchell et al. (2000) follow the McGuire and Pauly Model to analyze the impact of fee reductions for cataract extractions and joint repair procedures. They use Medicare claims data from 1991-1994 for ophthalmologists and orthopedic surgeons to conclude the Medicare Fee Schedule effects physicians' supply decisions. The substitution effect is dominant in the supply of cataract and joint repair surgeries. They conclude that physicians in certain markets are incentivized to increase volumes in a variety of the services they perform when fees are reduced.

Hadley and Reschovsky (2006) use empirical analysis following McGuire and Pauly to examine the market factors that influence the quantity of Medicare services a physician provides, using surveys and Medicare claims data. The three results indicate the quantity of service is positively related to price, is also dependent on other factors, and physicians who are incentivized to manipulate demand do so through a variety of services. Melichar (2008) utilizes a fixed effects regression to conclude physicians respond to financial incentives at the margin and that capitation may lead to more efficient and higher-quality care.

Hadley et al (2009) estimate the relationship between Medicare fees and the quantities of eight procedures provided by physicians. Results from 13,707 physicians' surveys from 2000 and 2005 show that there was a positive slopping supply curve and that there was no volume-offset behavior for these particular services.

# III. Methodology

## A. Data

The data set I created for analysis comes from three different sources collected by the Center for Medicare and Medicaid Services (CMS) including the years 2005-2008. I use the volumes of each preventative procedure performed by county which was derived from the Part B Extract and Summarization System (BESS) and the Outpatient SAF file. The preventative care services include: mammograms, pelvic exams, prostate cancer screenings, pneumonia vaccines and bone mass measurement tests. A description of each service is outlined in Table 1.

**Table 1. Medicare Preventative Service**

| Service | CPT Code | Suggested Frequency | Beneficiary Payment |
|---|---|---|---|
| Bone Mass Measurement | 76977 | Every 24 months | Copayment |
| Prostate Cancer Screenings | G0102 | Annually | No copayment |
| Pelvic Exams | G0101 | Annually to 24 months | No copayment |
| Mammograms | G0204 | Annually | No copayment |
| Pneumonia Vaccine | 90471* | Once in a lifetime (additional based on risk) | No copayment |

***CPT code changes to 70355 in 2008**

The National Physician Fee Schedule Relative Value Files contain all current procedure terminology (CPT) codes copyrighted by the American Medical Association and their respective RVUs. This file also contains all geographic price cost index (GPCI) codes for each county. The Fee for Service files records enrollment numbers for Medicare Part B beneficiaries. I then create a data set that matches each county's volume data with the respective geographic price cost locality values. The data containing the percentage of females and males over the age of 65 was

obtained from the United States Census Bureau's Community Demographics Survey. Summary statistics are provided in Table 2.

**Table 2. Summary Statistics**

| Variable | Observations | Mean | Std. Dev |
|---|---|---|---|
| Pneumonia Vaccine | 12463 | 4661.926 | 10639.33 |
| Mammograms | 12463 | 2273.109 | 5236.447 |
| Pelvic Exam | 10599 | 413.274 | 870.524 |
| Prostate Cancer Screenings | 12229 | 906.222 | 1788.85 |
| Bone Mass Measurement Screenings | 12179 | 880.283 | 2277.355 |
| Number of Part B Beneficiaries | 12576 | 8567.01 | 20993.49 |
| Work Relative RVUs | 12576 | 0.996 | 0.035 |
| Practice Expense RVUs | 12576 | 0.908 | 0.082 |
| Malpractice RVUs | 12576 | 0.802 | 0.312 |
| Conversion Factor | 12576 | 37.036 | 0.960 |

## B. Medicare Reimbursement Rate

Physicians are price takers when it comes to treating Medicare beneficiaries. All procedures that a physician provides to a patient are priced and reimbursed by the Physician's Fee Schedule. The resourced based relative value scale determines the fee schedule for physicians and is specified in relative value units (RVUs) for each service. The RVUs represent the amount of "work" devoted to the service, the practice costs associated with the service, and the malpractice costs. The three inputs are explained in Table 3.

**Table 3. Relative Value Units**

| Resource | Costs Associated with Each Service |
|---|---|
| Work Expense RVU | Time, effort, skill, stress |
| Practice Expense RVU | Office operating costs, supplies, technology, supplies, staff |
| Malpractice Expense RVU | Liability insurance premiums |

The total RVUs are then adjusted by the respective geographic price cost index in order to account for variations in the costs of the different factor inputs across different counties. The adjusted RVUs are then multiplied by the conversion factor to determine the final payment. Each Medicare Allowable Payment can be calculated using the following two formulas:

$$\text{Total RVU} = [(\text{Work RVUs} \times \text{Work GPCI}) + (\text{Practice Expense RVUs} \times \text{Practice Expense GPCI}) + \text{Malpractice RVUs} \times \text{Malpractice GPCI})] \quad (1)$$

$$\text{Medicare Allowable Payment} = \text{Total RVUs} \times \text{Conversion Factor} \quad (2)$$

The conversion factor is updated annually to adjust the targeted rate of growth in healthcare spending, the sustainable growth rate (SGR), to actual costs. The rate captures annual changes in resource costs, the number of beneficiaries and the rate of inflation. The conversion factor is a powerful policy instrument that affects all procedures in the fee schedule proportionately.

## C. Empirical Model

In order to examine the relationship between fee changes in the resource-based relative value scale and volume changes in Medicare procedures performed, I use the following model:

$$QMED_{it} = \alpha + \beta_1 WORK_{it} + \beta_2 PRAC_{it} + \beta_3 MAL_{it} + \beta_4 BEN_{it} + \beta_5 GEN_{it} + \beta_7 YEAR6 + \beta_8 YEAR7_t + \beta_9 YEAR8_t + \beta_9 CONV_{it} + \varepsilon_{it} \quad (3)$$

The variables and definitions are outlined in Table 4.

**Table 4. Variable Definitions**

| Variable | Definition |
|---|---|
| $QMED_{it}$ | The natural log of the Medicare service provided in county *i* in year *t* |
| $WORK_{it}$ | The work relative value unit for the service provided in county *i* in year *t* |
| $PRAC_{it}$ | The practice relative value unit for the service provided in county *i* in year *t* |
| $MAL_{it}$ | The malpractice relative value unit for the service provided in county *i* in year *t* |
| $BEN_{it}$ | The natural log of Medicare beneficiaries in county *i* in year *t* |
| $GEN_{it}$ | The percentage of the population over the age of 65 female or male in county *i* in year *t** |
| $CONV_t$ | The conversion factor in year *t* |

*Varies with the type of service

The dependent variable I am using is the natural log of preventative procedures provided to Medicare Part B beneficiaries by county in each year. I have transformed this variable to make interpretation easier when examining the estimated coefficients by percent changes rather than by overall changes. The dependent variable is in terms of the overall level of services, rather than service per beneficiary, allowing for uniform interpretation with previous research. The natural log of Medicare Part B beneficiaries was also included, to allow for percentage change interpretation, as a control variable. This model decomposes the final reimbursement rate into the four resource cost components, which are adjusted for geographic input price variations, in order to examine how changes in each component affect the quantity of the service provided by physicians. In order to control for differences across counties I use a fixed effects panel regression, based on the results of the Hausman Test. I do not control for inflation because this

change is represented in the conversion factor. Dummy variables to account for years 2006-2008 were added, using the year 2005 as a base year for comparison and to control for autocorrelation.

**IV. Results**

Results from the five Fixed-Effects panel regressions are presented in Table 5.

**Table 5. Fixed-Effects Panel Estimations with Robust Standard Errors**

| Dependent Variable | Model 1<br>Bone Mass Measurement | Model 2<br>Prostate Cancer Screenings | Model 3<br>Pelvic Exams | Model 4<br>Mammograms | Model 5<br>Pneumonia Vaccine |
|---|---|---|---|---|---|
| **Constant** | 6.181*** | 7.780*** | 7.028*** | 8.092*** | 8.497*** |
| **Medicare Part B Beneficiaries** | 0.001 | 0.008** | 0.007* | 0.004** | -0.001 |
| **Work Relative Value Units** | -0.106 | -0.021 | -0.982** | -0.802*** | -3.928*** |
| **Practice Expense Relative Value Units** | -0.121*** | -0.242 | 0.761*** | 1.895*** | 0.0659* |
| **Malpractice Expense Relative Value Units** | -0.038** | -0.198 | -0.045 | -0.007** | 0.004 |
| **Conversion Factor** | -0.008 | -0.005** | -0.005** | 0.002** | -0.063*** |
| **Percentage of the Relative Gender over 65** | -- | -0.005 | -0.001 | 0.004** | -- |
| **Year 2006** | 0.003 | -0.177* | 0.028** | -0.002 | -0.147*** |
| **Year 2007** | -0.183 | -0.037 | -0.192*** | 0.0232* | -0.325*** |
| **Year 2008** | -1.183 | -0.037 | -0.192*** | -0.013 | -0.209*** |
| $R^2$ | **0.22** | **0.06** | **0.03** | **0.05** | **0.08** |

***1% significance, ** 5% significance, * 10% significance

Consistent with economic theory, the decomposed price components are significant when regressed with volume. Although the service provided to a Medicare patient should only be

based on need, these estimations prove physicians' provision of services is affected by differences in Medicare payment rates. (Hadley et al. 2009) A one unit increase in the work relative value units for a pneumonia vaccine would decrease the number of vaccines provided by 3.98%. This result is consistent with the McGuire and Pauly Model when the income effect dominates.

When examining the relationship between practice expense and volume, a one unit increase in the practice expense decreases the volume of bone mass measurements, pelvic exams, and mammograms at a 1% significance level. A one unit increase in the malpractice expense decreases the volume of bone mass measurements, pelvic exams and mammograms at a 5% significance level. The results show the amount of reimbursement received to cover practice costs and malpractice costs matter to physicians in regards to these three preventative services. The benefit to decomposing the price into separate inputs, allows for potential insight into the accuracy of exogenous prices aligning with the actual costs. The greater difference between the RBRVS price and the actual cost to the physician, the stronger the incentive to induce demand. (Hadley et al. 2009) From 2000-2005, an 11 % decrease in overall reimbursement rates, compared to actual practice costs, was followed by a considerable increase in volume (MedPAC 2008a).

A one dollar increase in the conversion factor will decrease the volume of prostate cancer screenings by 0.02% and decreases the amount of pneumonia vaccines provided by 0.06% at a 1% significance level. While, a one dollar increase in the conversion factor will decrease the volume of pelvic exams by 0.005% at a 5% significance level. The negative relationship between the conversion factor and the number of services performed validates the theory that physicians pursue a "target income." Unlike a traditional economic market where the response to an

exogenous change in price would decrease the supply, the opposite relationship is shown (McGuire and Pauly 1991). An unexpected result is a positive coefficient for the conversion factor for mammograms when all other inputs have negative coefficients. This result requires further investigation in a future study. The dummy variables for the years 2006, 2007, and 2008 capture other effects that would affect volume from year to year including the impacts of policy changes.

According to previous research, the nature of the specialty and the degree to which physicians can manipulate demand, impact physicians' behavioral responses. The propensity to increase volume to offset a loss in income becomes greater the more the revenue a physician receives in a particular field depends on the administration of the particular service that has been reduced (McGuire and Pauly 1991). Primary care physicians are known as the "gateway" to Medicine, the nature of their field requires diagnostics to be a main objective. These preventative services are mainly administered by primary care physicians. The standard economic theory which defines the physician as a profit-maximizing agent will decrease the supply of a service that has been exogenously reduced; does not seem to apply to the nature of this field of medicine and to the elasticity of preventative services.

In order to examine the elasticity of each preventative service, I aggregated the four RBRVS components into one reimbursement rate. I then transform both the reimbursement rate and the number of services provided into natural log form. In a log-log model the coefficients represent the elasticity. The five Medicare preventative services at their respective elasticity's are represented in Table 5.

**Table 5. Elasticity**

| Medicare Preventative Service | Elasticity |
|---|---|
| Bone Mass Measurement | -0.017 |
| Prostate Cancer Screenings | -0.188 |
| Pelvic Exams | -0.046 |
| Mammograms | -0.077 |
| Pneumonia Vaccine | -0.020 |

All five services are very inelastic, further supporting the theory that physicians in a field that have little discretion over the provision of particular services will engage in "volume-offset" behavior rather than substituting to higher reimbursed services. (Hadley et al. 2009) With a relatively fixed number of beneficiaries, fixed practice expenses, and low ability for substitution, physicians are incentivized to increase the volume of the services they perform in order to maintain a constant level of income when fees are reduced (Yip 1998).

## V. Conclusion

The purpose of my analysis was to examine the relationship between the volume of preventative procedures performed for five services and changes in Medicare Fees. I have added to previous research by examining CPT codes that have not yet been empirically tested by county. Understanding how physicians' provision of services to Medicare patients is affected by changes in reimbursement rates is essential when considering future reforms to Medicare. The results from this study support previous theory that price does impact physicians' delivery of care decisions.

A limitation of this analysis is the consideration of only one market. Future research could expand this study to include the private market, allowing for examination of potential

"spill-over effects." Another limitation includes the absence of patient characteristics that would also impact the demand for each service. The ability to observe actual practice costs and physicians' preferences toward income and leisure would also enhance this study.

The financial incentives within the health care market are unique. In order for policy makers to be successful when determining fees, they must possess perfect information about how physicians' provision of services to Medicare beneficiaries are related to reimbursement rates in a variety of different specialties and services. The current system with uniform cuts does not accurately contain costs. This paper only examines five preventative services; however, it is necessary to understand a wide variety of services, practice behaviors, and specialties in order to make more efficient policy decisions for financing Medicare into the future under the current system. Recent efforts have been made to move away from quantity based reimbursements into a more efficient evidence-based care.

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## VII. Appendix

Hausman Specification Test

(With Sargn-Hansen test Statistics)

Ho: Difference in coefficients is not systematic.

**Model 1**

830.108 = Chi-sq(5)

0.000 = P-value

**Model 2**

870.188 = Chi-sq(5)

0.000 = P-value

**Model 3**

336.932 = Chi-sq(6)

0.000 = P-value

**Model 4**

345.32 = Chi-sq(6)

0.000 = P-value

**Model 5**

216.104 = Chi-sq(5)

0.000 = P-value

Pairwise Correlation Matrix

| | year | code | lnmam | lnpel | lnpro | lnvac | lnbone | lnben | women | male | cf | prowork | prope | promp | proprice | lnprope | bonework | bonepe | bonemp | bonepre |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | |
| year | 1 | | | | | | | | | | | | | | | | | | | |
| code | 0 | 1 | | | | | | | | | | | | | | | | | | |
| lnmam | -0.0077 | -0.0375 | 1 | | | | | | | | | | | | | | | | | |
| lnpel | 0.0001 | 0.0229 | 0.9344 | 1 | | | | | | | | | | | | | | | | |
| lnpro | -0.0055 | -0.0585 | 0.9659 | 0.8998 | 1 | | | | | | | | | | | | | | | |
| lnvac | -0.035 | -0.0187 | 0.9589 | 0.9217 | 0.9261 | 1 | | | | | | | | | | | | | | |
| lnbone | -0.0351 | -0.0274 | 0.9794 | 0.9233 | 0.9456 | 0.9542 | 1 | | | | | | | | | | | | | |
| lnben | -0.0224 | -0.0263 | 0.4815 | 0.401 | 0.4486 | 0.4386 | 0.4551 | 1 | | | | | | | | | | | | |
| women | 0.0899 | 0.1037 | 0.228 | 0.1967 | 0.1604 | 0.2045 | 0.1734 | 0.0005 | 1 | | | | | | | | | | | |
| male | -0.0907 | -0.1047 | -0.229 | -0.1989 | -0.1612 | -0.2054 | -0.1743 | -0.0007 | -1 | 1 | | | | | | | | | | |
| cf | 0.0429 | 0 | -0.0032 | 0.002 | -0.0041 | -0.0018 | -0.0047 | 0.0009 | -0.0839 | 0.0844 | 1 | | | | | | | | | |
| prowork | -0.2634 | -0.0054 | 0.0088 | 0.015 | 0.0138 | 0.022 | 0.0318 | 0.0065 | 0.0756 | -0.0759 | -0.5021 | 1 | | | | | | | | |
| prope | 0.7391 | -0.003 | 0.072 | 0.0816 | 0.0789 | 0.0565 | 0.0621 | 0.0526 | 0.0307 | -0.0312 | -0.0944 | -0.3546 | 1 | | | | | | | |
| promp | 0.9326 | -0.0194 | 0.051 | 0.0695 | 0.0469 | 0.0302 | 0.0297 | 0.0171 | 0.0795 | -0.0803 | -0.22 | -0.2546 | 0.7746 | 1 | | | | | | |
| proprice | 0.587 | -0.0193 | 0.0557 | 0.0767 | 0.0583 | 0.0492 | 0.0581 | 0.026 | 0.1223 | -0.1233 | -0.5273 | 0.5863 | 0.4177 | 0.6253 | 1 | | | | | |
| lnpropric | 0.654 | -0.0155 | 0.0398 | 0.0586 | 0.0435 | 0.0303 | 0.038 | 0.0145 | 0.1271 | -0.1282 | -0.5265 | 0.5126 | 0.4698 | 0.6924 | 0.9939 | 1 | | | | |
| bonework | -0.1333 | -0.1024 | 0.0495 | 0.1961 | 0.0801 | 0.1802 | 0.1358 | 0.0124 | -0.0265 | 0.0265 | 0.2257 | 0.1257 | -0.1243 | -0.1591 | -0.0075 | -0.029 | 1 | | | |
| bonepe | -0.8862 | -0.0161 | 0.0407 | 0.0507 | 0.0402 | 0.075 | 0.0792 | 0.0436 | -0.0642 | 0.0646 | 0.0072 | 0.5758 | -0.7751 | -0.8992 | -0.2883 | -0.3782 | 0.3065 | 1 | | |
| bonemp | 0.6692 | -0.0024 | 0.0543 | 0.0593 | 0.0581 | 0.0376 | 0.039 | 0.0375 | 0.024 | -0.0245 | -0.1716 | -0.4842 | 0.9585 | 0.7652 | 0.2824 | 0.348 | -0.1859 | -0.8145 | 1 | |
| bonepric | -0.7079 | -0.0313 | 0.1362 | 0.1633 | 0.1406 | 0.1773 | 0.1852 | 0.1207 | -0.0885 | 0.0887 | -0.1041 | 0.3409 | -0.172 | -0.6343 | -0.2114 | -0.2849 | 0.3282 | 0.7244 | -0.1937 | 1 |
| lnbonepri | -0.7063 | -0.019 | 0.1213 | 0.1411 | 0.1237 | 0.1581 | 0.1662 | 0.1158 | -0.0745 | 0.0748 | -0.1302 | 0.3565 | -0.1583 | -0.6338 | -0.1974 | -0.2721 | 0.2434 | 0.7099 | -0.1842 | 0.9841 |
| pelwork | -0.1333 | -0.1024 | 0.0495 | 0.1961 | 0.0801 | 0.1802 | 0.1358 | 0.0124 | -0.0265 | 0.0265 | 0.2257 | 0.1257 | -0.1243 | -0.1591 | -0.0075 | -0.029 | 1 | 0.3065 | -0.1859 | 0.3282 |
| pelpe | 0.8763 | -0.0214 | 0.0522 | 0.0706 | 0.0466 | 0.0333 | 0.0291 | 0.0206 | 0.0367 | -0.0373 | 0.0017 | -0.5731 | 0.7786 | 0.9361 | 0.3186 | 0.4006 | -0.1307 | -0.9543 | 0.8163 | -0.6412 |
| pelmp | 0.7672 | -0.0005 | 0.0493 | 0.0562 | 0.0531 | 0.0306 | 0.0317 | 0.0323 | 0.0271 | -0.0275 | -0.0217 | -0.506 | 0.9754 | 0.8025 | 0.3081 | 0.3738 | -0.1577 | -0.8555 | 0.9768 | -0.2794 |
| pelprice | 0.8499 | -0.0137 | 0.0541 | 0.0696 | 0.0551 | 0.0374 | 0.036 | 0.0292 | 0.0273 | -0.0278 | 0.0725 | -0.5704 | 0.9229 | 0.8714 | 0.303 | 0.3762 | -0.0875 | -0.9154 | 0.9244 | -0.4366 |
| lnpelprice | 0.8639 | -0.0125 | 0.0405 | 0.0549 | 0.0411 | 0.0227 | 0.02 | 0.0191 | 0.0315 | -0.0321 | 0.0695 | -0.5997 | 0.8901 | 0.8868 | 0.2832 | 0.3632 | -0.0986 | -0.9402 | 0.9048 | -0.5029 |
| mamwork | -0.1333 | -0.1024 | 0.0495 | 0.1961 | 0.0801 | 0.1802 | 0.1358 | 0.0124 | -0.0265 | 0.0265 | 0.2257 | 0.1257 | -0.1243 | -0.1591 | -0.0075 | -0.029 | 1 | 0.3065 | -0.1859 | 0.3282 |
| mampe | -0.028 | -0.1211 | 0.3058 | 0.4163 | 0.294 | 0.3773 | 0.3724 | 0.2072 | -0.0731 | 0.0727 | 0.1792 | 0.0647 | -0.0477 | 0.0562 | 0.105 | 0.0685 | 0.6308 | 0.2196 | -0.0999 | 0.2751 |
| mammp | 0.7758 | -0.0004 | 0.049 | 0.0561 | 0.0528 | 0.0302 | 0.0313 | 0.032 | 0.0271 | -0.0276 | -0.003 | -0.5064 | 0.9749 | 0.8035 | 0.3102 | 0.3755 | -0.1528 | -0.8567 | 0.9709 | -0.2868 |
| mamprice | 0.7699 | -0.0254 | 0.1057 | 0.1319 | 0.1063 | 0.0978 | 0.099 | 0.0712 | 0.0043 | -0.0048 | 0.1312 | -0.5186 | 0.9417 | 0.7837 | 0.2914 | 0.3479 | 0.0145 | -0.7954 | 0.9132 | -0.2388 |
| lnmampri | 0.799 | -0.0233 | 0.0971 | 0.1234 | 0.0965 | 0.0879 | 0.0879 | 0.0662 | 0.0079 | -0.0084 | 0.1284 | -0.5597 | 0.9237 | 0.8161 | 0.2762 | 0.3409 | -0.005 | -0.8357 | 0.9105 | -0.3114 |
| vacwork | -0.1333 | -0.1024 | 0.0495 | 0.1961 | 0.0801 | 0.1802 | 0.1358 | 0.0124 | -0.0265 | 0.0265 | 0.2257 | 0.1257 | -0.1243 | -0.1591 | -0.0075 | -0.029 | 1 | 0.3065 | -0.1859 | 0.3282 |
| vacpe | 0.7773 | -0.0552 | 0.1362 | 0.1794 | 0.1252 | 0.1337 | 0.1298 | 0.0798 | 0.008 | -0.0086 | -0.0262 | -0.5222 | 0.7164 | 0.8912 | 0.3164 | 0.3847 | 0.0358 | -0.8297 | 0.7588 | -0.498 |
| vacmp | 0.7897 | -0.0001 | 0.0481 | 0.0556 | 0.052 | 0.0291 | 0.0302 | 0.0312 | 0.0273 | -0.0278 | 0.0283 | -0.5066 | 0.9723 | 0.8045 | 0.3133 | 0.378 | -0.1449 | -0.8579 | 0.9595 | -0.3002 |
| vacprice | 0.8315 | -0.0199 | 0.0784 | 0.0996 | 0.0784 | 0.0652 | 0.0646 | 0.048 | 0.0176 | -0.0182 | 0.1014 | -0.5577 | 0.9275 | 0.8512 | 0.3025 | 0.37 | -0.0461 | -0.8788 | 0.9171 | -0.3799 |
| lnvacpric | 0.849 | -0.018 | 0.0667 | 0.0871 | 0.066 | 0.0522 | 0.0503 | 0.0398 | 0.021 | -0.0216 | 0.0948 | -0.5915 | 0.8987 | 0.8718 | 0.2828 | 0.3579 | -0.0623 | -0.9083 | 0.904 | -0.4466 |
| base year | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2006 | -0.2582 | 0 | 0.0055 | 0.0082 | 0.0098 | 0.0157 | 0.0258 | 0.0051 | 0.0764 | -0.0768 | -0.5157 | 0.9987 | -0.3504 | -0.2484 | 0.5892 | 0.5164 | 0.0763 | 0.5631 | -0.4775 | 0.3255 |
| 2007 | 0.2582 | 0 | -0.002 | -0.0094 | -0.0046 | -0.0146 | -0.0203 | -0.0074 | 0.0313 | -0.0317 | -0.6322 | -0.3475 | 0.4676 | 0.5305 | 0.1055 | 0.1735 | -0.3229 | -0.5703 | 0.6573 | -0.2271 |
| 2008 | 0.7746 | 0 | -0.0071 | 0.0036 | -0.0049 | -0.0256 | -0.0254 | -0.016 | 0.0309 | -0.0312 | 0.6302 | -0.328 | 0.4412 | 0.5318 | 0.2385 | 0.275 | 0.0751 | -0.5702 | 0.2969 | -0.5663 |

| | lnbone~e | pelwork | pelpe | pelmp | pelprice | lnpelp~e | mamwork | mampe | mammp | mamprice | lnmamp~e | vacwork | vacpe | vacmp | vacprice | lnvacp~e | base year | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| year | | | | | | | | | | | | | | | | | | | | |
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| lnvac | | | | | | | | | | | | | | | | | | | | |
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| proprice | | | | | | | | | | | | | | | | | | | | |
| lnproprice | | | | | | | | | | | | | | | | | | | | |
| bonework | | | | | | | | | | | | | | | | | | | | |
| bonepe | | | | | | | | | | | | | | | | | | | | |
| bonemp | | | | | | | | | | | | | | | | | | | | |
| boneprice | | | | | | | | | | | | | | | | | | | | |
| lnbonepri | 1 | | | | | | | | | | | | | | | | | | | |
| pelwork | 0.2434 | 1 | | | | | | | | | | | | | | | | | | |
| pelpe | -0.6509 | -0.1307 | 1 | | | | | | | | | | | | | | | | | |
| pelmp | -0.2673 | -0.1577 | 0.8557 | 1 | | | | | | | | | | | | | | | | |
| pelprice | -0.4381 | -0.0875 | 0.9427 | 0.9713 | 1 | | | | | | | | | | | | | | | |
| lnpelprice | -0.5067 | -0.0986 | 0.9653 | 0.9498 | 0.9943 | 1 | | | | | | | | | | | | | | |
| mamwork | 0.2434 | 1 | -0.1307 | -0.1577 | -0.0875 | -0.0986 | 1 | | | | | | | | | | | | | |
| mampe | 0.194 | 0.6308 | 0.0753 | -0.0681 | 0.0329 | 0.0201 | 0.6308 | 1 | | | | | | | | | | | | |
| mammp | -0.2745 | -0.1528 | 0.8568 | 0.9997 | 0.9736 | 0.9518 | -0.1528 | -0.0634 | 1 | | | | | | | | | | | |
| mamprice | -0.2455 | 0.0145 | 0.856 | 0.9661 | 0.9711 | 0.9461 | 0.0145 | 0.1606 | 0.9697 | 1 | | | | | | | | | | |
| lnmampri | -0.3187 | -0.005 | 0.897 | 0.961 | 0.9828 | 0.9704 | -0.005 | 0.1556 | 0.9641 | 0.9921 | 1 | | | | | | | | | |
| vacwork | 0.2434 | 1 | -0.1307 | -0.1577 | -0.0875 | -0.0986 | 1 | 0.6308 | -0.1528 | 0.0145 | -0.005 | 1 | | | | | | | | |
| vacpe | -0.5292 | 0.0358 | 0.958 | 0.7843 | 0.885 | 0.9043 | 0.0358 | 0.3384 | 0.784 | 0.8344 | 0.8733 | 0.0358 | 1 | | | | | | | |
| vacmp | -0.2875 | -0.1449 | 0.8579 | 0.9975 | 0.9762 | 0.9539 | -0.1449 | -0.0558 | 0.999 | 0.9741 | 0.9678 | -0.1449 | 0.7829 | 1 | | | | | | |
| vacprice | -0.384 | -0.0461 | 0.9241 | 0.9697 | 0.996 | 0.9844 | -0.0461 | 0.0992 | 0.9729 | 0.9872 | 0.9931 | -0.0461 | 0.8835 | 0.9768 | 1 | | | | | |
| lnvacprice | -0.4534 | -0.0623 | 0.9524 | 0.9533 | 0.9951 | 0.9958 | -0.0623 | 0.0887 | 0.9558 | 0.9667 | 0.987 | -0.0623 | 0.9095 | 0.959 | 0.9932 | 1 | | | | |
| base year | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | | | |
| 2006 | 0.3457 | 0.0763 | -0.5698 | -0.5008 | -0.5691 | -0.5981 | 0.0763 | 0.0314 | -0.5014 | -0.5224 | -0.5629 | 0.0763 | -0.5276 | -0.502 | -0.5585 | -0.5919 | . | 1 | | |
| 2007 | -0.2162 | -0.3229 | 0.5656 | 0.5222 | 0.4861 | 0.5158 | -0.3229 | -0.2248 | 0.5031 | 0.3751 | 0.4158 | -0.3229 | 0.5513 | 0.4706 | 0.4439 | 0.4816 | . | -0.3333 | 1 | |
| 2008 | -0.579 | 0.0751 | 0.567 | 0.479 | 0.5971 | 0.599 | 0.0751 | 0.1153 | 0.4994 | 0.5867 | 0.5981 | 0.0751 | 0.4773 | 0.5333 | 0.6059 | 0.6069 | . | -0.3333 | -0.3333 | 1 |