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August 1, 2005

VIA HAND DELIVERY
Joseph A. Spetrini
Acting Assistant Secretary
for Import Administration
U.S. Department of Commerce
Central Records Unit
Room 1870
Fourteenth Street and Constitution Avenue, NW
Washington, D.C. 20230

Re: Expected Non-Market Economy Wages: Request for Comment on Calculation Methodology

Dear Acting Assistant Secretary Spetrini:

These comments are filed on behalf of the Ministry of Commerce of the People's Republic of China, in response to the U.S. Department of Commerce's June 30, 2005 Federal Register notice, Expected Non-Market Economy Wages: Request for Comment on Calculation Methodology, 70 Fed. Reg. 37761.

An original and six copies of these comments are attached. Also, we provide the comments in Adobe "pdf" format on a CD-ROM.

If you have any questions, please contact the undersigned.

Sincerely,

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Before the United States Department of Commerce
International Trade Administration

Comments of the Ministry of Commerce, People's Republic of China

on

Calculation Methodology for Expected Non-Market Economy Wages

August 1, 2005

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A	Expert Opinion of Daniel W. Klett (with Internal Attachments 1-16)	PUBLIC
B	Wage Estimates for 5 Countries Designated As Potential Surrogates for China	PUBLIC

I. INTRODUCTION

This submission provides the comments of the Ministry of Commerce of the People's Republic of China ("MOFCOM") concerning the Department of Commerce's (the "Department") calculation of the expected non-market economy wage used to value Chinese respondents' factors of production in antidumping cases. These comments are submitted in response to the Department's Federal Register notice of June 30, 2005.[1] MOFCOM appreciates the opportunity to submit these comments and to contribute to the discussion of this issue.

The Department's request for public comment results from the Department's inability to address certain complicated arguments raised regarding the labor rate calculation in *Wooden Bedroom Furniture from the People's Republic of China*, Case No. A-570-890. Numerous arguments were made regarding potential distortions in the Department's calculation of the 2002 wage rate. The Department stated, however, that--

> it would be inappropriate to restrict this public-comment process to the context of the instant investigation, and, consequently, we will invite comments from the general public on this matter in a proceeding separate from the current investigation. Finally, the Department requires more time than is currently available in this investigation to determine an accurate construction of a new dataset and to conduct a new regression analysis.

Issues and Decision Memorandum, Wooden Bedroom Furniture from the People's Republic of China at 180-181 (November 17, 2004). Thus, despite receiving arguments from the Chinese respondents in that case, the Department declined to consider those arguments and demurred until the instant public comment proceeding. MOFCOM

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[1] *See* Expected Non-Market Economy Wages: Request for Comment on Calculation Methodology, 70 Fed. Reg. 37761 (June 30, 2005).

welcomes the Department's desire finally to address the substance of these important issues.

The Department doesn't recognize China as a market economy country, and uses non-comparable surrogate data to determine the wage rate for China. This does not comport with the reality in China. China has already established a market-based income distribution system following the implementation of reforms and market-opening. Although the average labor rate has been significantly increased, it is still much lower than that of the developed countries, largely attributed to the oversupply in the Chinese labor market, which can not be solved in a short period time.

It remains MOFCOM's general position that the Department's non-market economy methodology is often implemented in a manner which is unfair to Chinese respondents. Even the United States courts have recognized that the Department's NME methodology results in the use of "fictional" surrogate values. Olympia Industrial v. United States, 7 F. Supp. 2d 997, 1001 (1998). The analysis of the Department's past and present practice with respect to the calculation of the surrogate wage rate for China, provided below, exposes yet another regrettable and punitive methodology employed by the Department to the detriment of Chinese respondents.

II. THE DEPARTMENT'S LABOR RATE METHODOLOGY IS CONTRARY TO THE U.S. STATUTE

A. The Department's Regulation is *Ultra Vires*

Section 773(c)(4)(A) requires the Department to value the factors of production, including labor hours as specified in Section 773(c)(3)(A), in one or more market economy countries that are "at a level of economic development comparable to that of the nonmarket economy country" and which are "significant producers" of comparable merchandise. 19. U.S.C. § 1677b(c). In 1997, the Department promulgated a regulation, 19 CFR § 351.408(c)(3), which sets forth a methodology for calculation of the surrogate labor rate not based on countries at a level of economic development comparable to China, but rather, based on a large group of market economy countries, such as Switzerland, the United Kingdom, the United States, and Canada which are not comparable to China in terms of economic development. While the Department's calculation includes within it surrogate wage rates for countries which are economically comparable to China, such as India, the regulation also permits inclusion of countries far apart from China in terms of economic development. The Department's regulation also permits valuing factors of production using data from countries which are not significant producers of comparable merchandise. As such, 19 CFR § 351.408(c)(3) runs contrary to the plain language of the statute, which instructs the Department to value labor in countries that are "at a level of development economically comparable to that of the nonmarket economy country" and that are significant producers of comparable merchandise.

That the Department's methodology uses data from comparable countries within the calculation (*e.g.*, India) demonstrates that Commerce could comply with the statutory direction to use comparable data in valuing the labor factor of production. But the regulation at issue, 19 C.F.R. § 351.408(c)(3), impermissibly allows the Department to mix in data from high wage countries and countries which are not significant producers of comparable merchandise.

The Supreme Court has stated: "If the intent of Congress is clear, that is the end of the matter; for the court, as well as the agency, must give effect to the unambiguously expressed intent of Congress." *Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842-43, 104 S. Ct. 2778, 81 L. Ed. 2d 694 (1984). "A regulation cannot override a clearly stated statutory enactment." *Aerolinias Argentinas v. United States*, 77 F.3d 1564 (Fed. Cir. 1996). Therefore, the Department's regulation permitting Commerce to utilize wage and income data from countries that are not economically comparable runs contrary to express intent of the United States Congress and must be declared invalid.

In the past, the Department's answer to this argument was that "Section 351.408(c)(3) of the Department's regulations directs the Department to value labor in the calculation of antidumping duties in cases involving NME countries." See, e.g., *Issues and Decisions Memo, Wooden Bedroom Furniture* at 179. In other words, the Department's answer to the argument that the regulation is unlawful is that the Department followed the regulation. MOFCOM fails to understand how this circular logic comports with the Department's obligation to provide a rational basis for its decisions.

B. The Department Intended to Include Language in its Regulation That Would Limit the Regression Calculation Only To Countries Which are Economically Comparable to the NME

The current regression regulation language mistakenly omits language that was originally proposed by the Department limiting the regression calculation to countries which are economically comparable to China. 19 CFR §351.408(c)(3) as originally proposed in 1996 stated:

> *Labor*. For labor, the Secretary will use regression-based wage rates reflective of the observed relationship between wages and national income in market economy countries found to be economically comparable to the nonmarket economy country under section 773(c)(4)(A) of the Act. The Secretary will calculate the wage rate to be applied in nonmarket economy proceedings each year. The calculation will be based on current data, and will be made available to the public.

Antidumping Duties; Countervailing Duties: Notice of Proposed Rulemaking and Request for Public Comments, 61 Fed. Reg. 7308, 7384 (February 27, 1996) (emphasis added).

The Department explained in its preface to the regulations that, “Because of the variability of wage rates in countries with similar per capita GDPs, paragraph (c)(3) directs the Department to use what is essentially an average of wage rates in market economy countries viewed as being economically comparable to the NME.” Id. at 7345 (emphasis added).

When the Department published the final regulations on May 19, 1997, the Department carefully listed the comments received, relating principally to the economic theory behind the regression itself, and the “significant producer” requirement, and stated, “After a further review of paragraph (c)(3) and the comments relating thereto, we have left paragraph (c)(3) unchanged.” Antidumping Duties; Countervailing Duties; Final Rule, 62 Fed. Reg. 27296, 27367 (May 19, 1997) (emphasis added).

However, despite the Department’s intention to leave paragraph (c)(3) of §351.408 “unchanged,” and despite the Department’s statement when promulgating the regulation that the regression calculation is based on countries “viewed as being economically comparable to the NME” (61 Fed. Reg. at 7345), the portion of paragraph (c)(3) in the 1996 proposed labor regulation that limited the regression to countries economically comparable with the NME was inadvertently omitted from the final version. The final version (which is the current version today), states:

> *Labor*. For labor, the Secretary will use regression-based wage rates reflective of the observed relationship between wages and national income in market economy countries. The Secretary will calculate the wage rate to be applied in nonmarket economy proceedings each year. The calculation will be based on current data, and will be made available to the public.

62 Fed. Reg. at 27414 (May 17, 1997). The Department omitted the language "found to be economically comparable to the nonmarket economy country under section 773(c)(4)(A) of the Act" that appeared in the 1996 proposed paragraph (c)(3).

That this was an inadvertence is confirmed by the Department's statement that "After a further review of paragraph (c)(3) and the comments relating thereto, we have left paragraph (c)(3) unchanged."[2] The Department also affirmatively rejected one proposal to limit the countries included in the regression calculation to countries which are also significant producers of comparable merchandise, stating, "When looking at a surrogate country to obtain labor rates, we believe it is appropriate to place less weight on the significant producer criterion, because economic comparability is more indicative of appropriate labor rates." Id. at 27367 (emphasis added).

Nowhere did the Department state that it was intentionally deleting the language from the 1996 proposed regulation limiting the regression calculation to countries which are economically comparable to the NME. On the contrary, the Department (1) confirmed that "we have left paragraph (c)(3) unchanged" and (2) that the Department

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[2] Antidumping Duties; Countervailing Duties; Final Rule, 62 Fed. Reg. 27296, 27367 (May 19, 1997) (emphasis added).

affirmatively endorsed economic comparability as the primary threshold requirement for evaluating which countries should be included in the regression calculation.

It is now clear that the Department's intention in promulgating the regulation was to follow the statute's requirement that factors of production be valued using surrogate data from countries that are economically comparable to the NME. It appears that a mistake of enormous significance was made when the May 19, 1997 regulations were published, a mistake which has resulted in the overstatement of the surrogate labor rates in Chinese cases for more than eight years.

The Department cannot justify the inclusion of non-comparable countries in the regression calculation, since this is inconsistent with the statute, as explained in part II.A above, and is inconsistent with the Department's intention in developing the regulation.

C. The Department's Methodology Requires Use of China's GDP Figure, Based on China's Income and Costs, Which the Department Designates as "Distorted" by Non-Market Forces

The last step in the Department's regression methodology introduces even more logical inconsistencies into the result. The Department rejects China's costs and prices under the theory that such prices and costs are "distorted" by government intervention. Yet, in the last step of the Department's regression calculation, the Department improperly multiplies the market economy regression coefficient for the per-capita GNI variable by China's per-capita GNI. GNI is a figure based on national <u>income</u>, which necessarily is a function of costs and prices -- the very elements of China's economy that the Department considers to be unreliable due to alleged intervention by the Chinese government.

Of course, the Government of the People's Republic of China strongly disagrees that its prices and costs are distorted and unsuitable for use in antidumping cases according to market economy calculation methodologies. However, since the United States maintains that such prices and costs are distorted, then the Department's use of China's GNI figure in the labor equation is inconsistent with this position, illogical, and wholly unjustified.

D. The Department Should Use the Wage Rate from India

Given the Department's statutory obligation to calculate dumping margins as accurately as possible, its methodology utilizing China's national income figure, which the Department deems to be unreliable, does not achieve that goal. The Department can avoid this distortion by following the statute's directive to value the factors of production in "comparable" economies and using the wage rate of India which is already a component of the Department's calculation. In the past, the Department has rejected this argument, stating that the regulation requires the Department to calculate wages according to the regression methodology. However, the Department's regulation is unlawful, as explained above. The Department's reasoning for rejecting the Indian surrogate wage rate therefore lacks a legal basis.

The Indian wage rate is already being used by the Department. For example, in the Sample 2003 calculation, the Department has used as one of its data points the publicly available, country-wide wage rate for India of **$0.23**/hour. *See*, http://ia.ita.doc.gov/wages/03wages/03wages.html. The Department designates India as the "primary" surrogate country in most antidumping investigations of China. Yet the Department's complicated calculation operates to replace the wage rate in a comparable surrogate country by a wage rate that is over 325% higher, **$0.98**.

The reason the Department's wage rate is higher is plain from the non-comparable source countries, such as Switzerland, the U.K., Norway, Germany that the Department includes in its calculation. The regression analysis considers these high-wage countries in deriving the wage rate for China, whose GDP is dramatically lower. For example, Norway's GNI used in the DOC's calculation is $43,400, which is nearly 4000% higher than China's 2003 GNI of only $1100. The inclusion of non-comparable countries in the regression analysis does not comport with the statutes' directive that wages be valued in a comparable surrogate country. 19 U.S.C. §1677b(c)(4)(A).

III. THE DOC SHOULD USE ONLY ECONOMICALLY COMPARABLE COUNTRIES IN ANY CALCULATION

A. The Department Should Value The Labor Factor of Production Using only Data from the Individual Surrogate Countries Designated as "Economically Comparable" in This Case

When calculating the annual expected wage for China, the Department should remove all of the countries from the regression calculation that are not economically comparable to China, the inclusion of which forces the Department to depart from the statute's directive to value the FOP based on data from economically comparable countries. This is one way in which the Department can arrive at a lawful labor rate that comports with the statute's directive to value factors of production in countries which are economically comparable and significant producers of comparable merchandise.

In the *Furniture* case, for example, the Department designated India, Pakistan, Indonesia, Sri Lanka, and the Philippines as economically comparable to China.[3] Of these five countries, the Department's Sample 2003 calculation already includes wage rates for India ($0.23), Pakistan ($0.38), Sri Lanka ($0.34) and the Philippines ($0.80).

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[3] *See*, Memorandum from Jon Freed to The File, Antidumping Investigation of Wooden Bedroom Furniture from the People's Republic of China: Selection of Surrogate Country (March 8, 2004).

These countries' wage rates are included in the DOC's current calculation. Indonesia's wage rate is ($0.41). *See*, Exhibit A hereto at Attachment 5.[4]

The simple average wage rate for these economically comparable countries is **$0.43**/hour. *See*, Exhibit B.

If the DOC applies its regression methodology limited solely to these five countries designated as economically comparable, the result is **$0.65**. *See* Exhibit B.

Finally, another benchmark to see that the inclusion of non-economically-comparable countries, in contravention of the statute, does indeed distort the result is to conduct the regression analysis only on countries within the "lower" and "lower-middle-income" countries within the World Bank data.[5] If the regression methodology required under the regulation is applied only to these countries, the estimated wage rate for China would be **$0.66**, somewhat higher than when the calculation is done only on the 5 countries designated as economically comparable to China in the *Furniture* case. *See,* Exhibit A at Attachment 9. This establishes that the mix of countries within the "lower" or "lower-middle-income" groups of the World Bank is close to the 5 countries designated by the Department as economically comparable to China.

B. The Department's Calculation Arbitrarily Ignores Data from Additional Market Economy Countries

The "notes" to the Department's annual wage updates typically state, "The selection of countries was based upon the availability of wage data as reported in the

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[4] We note that the Department's calculation inexplicitly leaves out Indonesia, which is typically designated by the Department as one of the acceptable surrogate country in terms of economic comparability with China. Wage rate data for Indonesia that satisfies the Department's country-selection criteria is, and has been, available on the ILO's website, and per-capita GNI is available from the World Bank for 2003.

[5] The 5 countries designated as economically comparable by the DOC in *Furniture*, for example, fall within these same two groups. *See* Exhibit A at Attachment 5.

Yearbook of Labour Statistics". *See, e.g.*, November 2004 wage calculation update.[6] This statement confirms that the Department intends to extract all data that is "available" in the ILO data. However, a comparison of the actual data extracted with the source data available from the ILO confirms that this is not the case. Rather, the Department is actively excluding many qualified countries at the first stage of its extraction, with no legal or statistical justification.[7]

The *Furniture* respondents argued during the original investigation that the Department arbitrarily excluded numerous countries from the pool of countries used in the regression calculation, without any legal or statistical justification. In the final determination, the Department did not address this criticism, saying instead that the fundamental argument required more time to consider than was available during the original proceeding. *See* Memorandum from Jeffrey A. May to James J. Jochum: Issues and Decision Memorandum for the Less-Than-Fair-Value Investigation of Wooden Bedroom Furniture from the People's Republic of China at 180-181 (November 8, 2004) ("Furniture Issues and Decision Memo").

Now, the Department has had many months to consider this issue, and is actively reconsidering its 2002 wage calculation in the context of voluntary remands requested in the *Furniture* appeals.[8] Yet the Department continues to avoid addressing one of the main criticisms of the calculation, namely, that the Department's starting dataset for the

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6 *See*, http://ia.ita.doc.gov/wages/02wages/02wages.html#notes.

7 This section of the submission does not concede that all countries should be included in the regression analysis, regardless of the level of economic development (see above). The intent is to show how the Department's current methodology (flawed though it is by inclusion of data from countries not economically comparable to China) is also distortive due to an arbitrary exclusion of countries from the analysis.

8 Dorbest Limited v. United States, Court No. 05-0003; Lacquer Craft Manufacturing Company v. United States, Court No. 05-00083.

regression calculation is invalid because it excludes countries for which data is available both from the ILO and World Bank, and which meet the Department's stated criteria for country-selection from that database.

In the context of the *Furniture* remand, the Department conceded that the November 2004 calculation of 2002 wages was incorrect.[9] The Department generated an entirely new wage rate calculation for that remand proceeding, and no longer relied on the data posted to the website during the investigation. The wage rate calculated in the draft remand results was **$0.85**/hour -- down from the original calculation of **$0.93**/hour.[10]

The Department's Sample 2003 wage rate calculation, yields a wage rate of **$0.98**/hour. This result is highly distorted by the exclusion of countries for which data was available in the ILO and World Bank sources used by the Department.[11] Specifically, the Department omitted the following 23 countries from the calculation:

These countries are:[12]

Albania	Indonesia	Malta**
Cambodia	Iran	Mongolia
Czech Republic	Kazakhstan*	Portugal**
Denmark**	Kuwait	Serbia & Montenegro
Fiji**	Latvia	Seychelles**
Hong Kong	Lithuania*	Slovakia
Hungary	Luxembourg**	Uruguay

[9] *See*, Memorandum from John D. A. LaRose to the File: Draft Redetermination According to Remand: Wooden Bedroom Furniture from the People's Republic of China at 3 (July 7, 2005) ("the Department now recognizes that the November 2004 wage rate calculation was in error").

[10] Id.

[11] We are attaching to these Comments the complete ILO and World Bank source data, including the countries ignored by the Department. We submit the information that the Department specifically ignored in Exhibit A, Attachments 2 and 4.

[12] *See* **Exhibit A**, **Attachment 2**. Although wage rate and per-capita GNI data also were available for Bahrain and Gambia, a 2003 consumer price index (CPI) was not available in the International Financial Statistics of the IMF to inflate pre-2003 wage rate data.

Iceland	Macedonia	

* Kazakstan received market economy status in 2001, and Lithuania in January 1, 2003. Because the ILO wage rates available for these countries are for 2003, their data should be used in the analysis. Although Estonia also received market economy status in 2003, the latest wage rate available for this country was for 2002.

** These countries have been included by Commerce in previous years for its analysis. *See* **Exhibit A**, **Attachment 3**.

The starting point for the Department's calculation was to extract only 56 of the available countries' data from the ILO and World Bank datasets. That the Department is explicitly filtering out data not from these 56 countries is proven by the raw source file provided on its website that was extracted on May 24, 2005. In the file, "ILO Wages.xls", there is a cell, C6, in which the Department lists only the 56 countries for which data was extracted: "AR AT AU BE BG BO BR BW CA CH CL CO CR DE DO DZ EC EG ES FI FR GB GR GT HR IE IL IN JO JP KE KR LK MU MX MY NI NL NO NZ PA PE PH PK PL PY SE SG SI SV TH TR TT US ZA ZW". However, an extraction of data from that same source on June 30, 2005 demonstrates there are many more countries with wage rate data reported by the ILO. Of these additional countries, there are another 23 which meet Commerce's selection criteria, and for which World Bank 2003 per-capita GNI are also available, listed above, that the Department continues to ignore.[13]

The Department has no consistent past practice of using only these same 56 countries in its analysis. Attachment 3 to Exhibit A hereto demonstrates that the composition of the countries used in the starting dataset has changed from time to time since the Department began implementing the regression analysis methodology. Some

[13] Hard copy excerpts from these two wage-rate extractions from the ILO's website are at Attachment 2 to Exhibit A.

countries which are left out of the calculation today were, in fact, once used in the Department's calculation. *See, e.g.*, Exhibit A at Attachment 3 (showing that DOC used Denmark, Fiji, Bahrain, Luxemborg, Malta, Seychelles, and Portugal in the past). Moreover, when the Department has changed the countries included in the pool in the past, it has done so without any explanation whatsoever. Nor has the Department ever explained why it uses only these 56 countries. Perhaps recognizing this, the Department does not claim that use of the 56 countries is an administrative practice, nor could it. Rather, the Department states simply that its analysis starts with 56 countries and acts as if the other 23 countries do not exist. Where, as here, limiting the starting dataset to fewer countries than are available is statistically and economically indefensible, the Department cannot fall back on a "practice" of committing the same error in the past simply because it was not challenged.

There is no rational economic basis for calculating a worldwide average wage rate based on a regression analysis using only a subset of "cherry-picked" countries' data. In promulgating the current regulation regarding the regression wage rate calculation, the Department stated: "We believe that more data is better than less data, and that averaging multiple data points (or regression analysis) should lead to more accurate results." *Comments on Final Rules*, 62 Fed. Reg. at 27,367 (May 19, 1997). Put in another way, less data is less accurate. The Department stated that the regression methodology "enhances the accuracy, fairness, and predictability of our AD calculations in NME case." *Id*. However, if the Department arbitrarily selects a subset of worldwide wages to calculate the wage rate each year, and ignores data that is available to exporters worldwide who could replicate the results of the DOC's calculation and adjust prices accordingly, then there is no predictability at all in the process. The dumping proceeding is transformed from remedial to punitive. Furthermore, even if limiting its analysis to 56 countries were to make the results more "predictable," accuracy of the results is of equal (if not greater) importance.

The Department's decisions can not be arbitrary. 19 USC § 1516a(b)(1)(A). The Department has articulated no basis for excluding countries for which ILO data was available when calculating its Sample 2003 wage rates. The Department has an obligation to calculate dumping margins as accurately as possible. *See Lasko Metal Prods. Inc.*, 43 F.3d 1442,1446 (Fed. Cir. 1994) ("The Act sets forth procedures in an effort to determine margins 'as accurately as possible.' ") *quoting Rhone Poulenc, Inc. v. United States*, 899 F.2d 1185, 1991 (Fed. Cir. 1991); *NTN Bearing Corp. v. United States*, 74 F.3d 1204, 1208 (Fed. Cir. 1995) ("It is the duty of ITA to determine dumping margins as accurately as possible.") (internal quotation omitted). The Department has stated that, with respect to the calculation of wage rates, more data equals more accuracy in the regression analysis used to calculate the wage rate. *Antidumping Duties, Countervailing Duties, Final Rule*, 62 Fed. Reg. 27,296, 27,367 (May 19, 1997) ("*Comments on Final Rules*"). Therefore, exclusion of any market economy country from the regression analysis for which data was available would be contrary to law.

If the other 23 countries that the Department arbitrarily left out are included in the regression analysis, the wage rate for China is **$0.77**/hour, using the same dataset utilized by the Department, but with the addition of the countries in the threshold artificial filtering done by the Department when extracting the data from the ILO website. *See*

Exhibit A, Attachment 7. The Department did not apply such a filter when extracting the World Bank per-capita GNI data, but rather used all data (for all countries) in that source.

C. The Department's Calculation is Statistically Unsound

MOFCOM is providing as Exhibit A hereto an expert opinion from a U.S. economist, Daniel W. Klett of Capital Trade, Inc. This opinion confirms that the Department's methodology is statistically unsound, as discussed below.

1. Regression Estimates From a Dataset Based on Only a Subset of Available Data is Not Valid

According to Mr. Klett, standard econometric theory weighs against estimating a relationship between variables using only a subset of arbitrarily-selected datapoints when additional data is available for other market economy countries in the world. Specifically, Mr. Klett quotes a standard econometric text which states that "As we move from a smaller sample size to a larger one, two things happen: (a) the bias becomes smaller, and (b) the estimates become less dispersed ... If it is at all possible to increase sample size, then we can buy greater reliability by spending more on sampling." Expert Opinion of Daniel W. Klett, Principal, Capital Trade Incorporated (attached hereto as Exhibit A at 4) (citing Elements of Econometrics, Jan Kmenta, 1971 at 11-13).

The Department did not dispute this fundamental proposition raised by the *Furniture* respondents in that investigation. Rather, the Department stated, "the Department agrees in part with Dorbest that a recalculation of the regression analysis may require the Department to expand the basket of countries it includes in its regression analysis. A review of the data shows, however, that it may be appropriate to include substantially more than the nineteen countries which Dorbest identified." *Furniture Issues and Decision Memorandum* at 180. MOFCOM submits that the purported existence of additional countries is not supported by any facts whatsoever. The *Furniture* respondents below argued that the Department should use all available data in the ILO source data, just as the Department has done for the World Bank data. The Department's response to the *Furniture* respondents' point during the investigation did not appear to address the issue raised, but instead raised the possibility of another dataset which is non-existent.

Now, pursuant to this public comment proceeding, the Department has the opportunity to make the calculation statistically sound, by using all the "available" data, rather than an arbitrarily-selected subset, as the starting point for its analysis. This would comport with the principle that "more data is better than less data, and that averaging multiple data points (or regression analysis) should lead to more accurate results." *Comments on Final Rules*, 62 Fed. Reg. at 27,367 (May 19, 1997). It would also implement the Department's apparent intention to use "available" data from the ILO and World Bank, as stated in the "notes" section in its November 2004 calculation of the labor rate, rather than some artificially limited extract.

2. The Department's Calculation Is, In Fact, Distorted By The Arbitrary Exclusion of the Additional Countries

The expert opinion of Mr. Klett confirms that the Department's calculation is biased against China. This is proven by the results when the additional market economy countries' data are included in the regression calculation, to calculate a true "world wide" correlation of wages and income based on all available data.

As shown in Attachment 7 to Exhibit A hereto, when the Department includes the 23 other countries for which data are available for 2003, the wage rate falls to **$0.77**/hour.

The results of excluding and including these countries can be seen below:

	Constant	GNI Coefficient
DOC 52-Country Data Subset[14]	0.410	0.00051
All 75 Countries	0.210	0.00051

The reason for the distortion is the inclusion of higher-average wage and income countries in the calculation, and the exclusion of lower-average wage and income countries. As explained by Mr. Klett, the bias toward higher-average wage countries affects the Y-intercept. *See*, Klett Opinion at 7 ("Exclusion from the analysis of countries which have, on average, lower wages and per-capita GNI results in the linear trend line being at a higher point (and parallel to) the regression line that uses all available data.").

Mr. Klett notes, "This distortion will not be restricted to 2003 Base Year results, but is likely to systematically overstate the estimated wage rates for NMEs in all years where such calculations are made." *See*, Klett Opinion, at 8. In fact, according to Mr. Klett's analysis of the Department's wage rate calculations for five years, from 1999 to 2003, it is clear that the arbitrary exclusion of countries from the regression calculation has consistently and systematically overstated the wage rate for China.

First, as illustrated in the following table, the countries arbitrarily excluded by the Department have an average per-capita GNI and wage rate that is consistently lower than those countries which were included in the Department's regression analyses:

	Wage Rates For Countries Used in Regression Analysis ($/hr.)		Per-Capita GNI For Countries Used in Regression Analysis ($)	
	DOC-Included	DOC-Excluded	DOC-Included	DOC-Excluded
1999	5.30	3.60	10,324	8,686
2000	5.03	3.95	10,561	8,858
2001	5.05	3.60	10,380	8,374
2002	5.56	3.57	10,726	7,773
2003	6.69	4.61	12,197	9,936

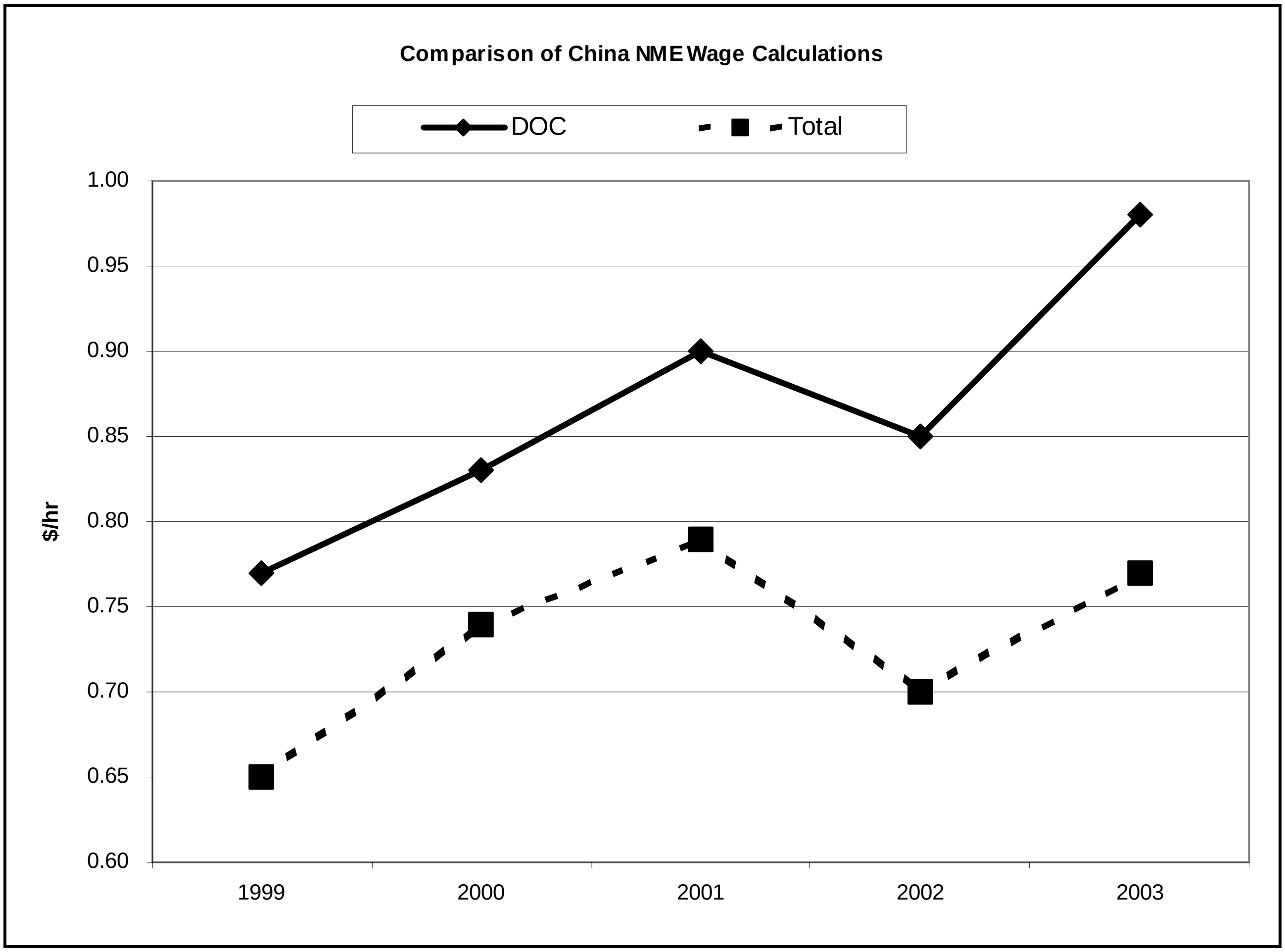
[14] The Department disqualified 4 of the 56 countries extracted from the ILO dataset, leaving only 52 that were actually used in the regression analysis.

The impact on the resulting wage rate for China is shown in the following table:

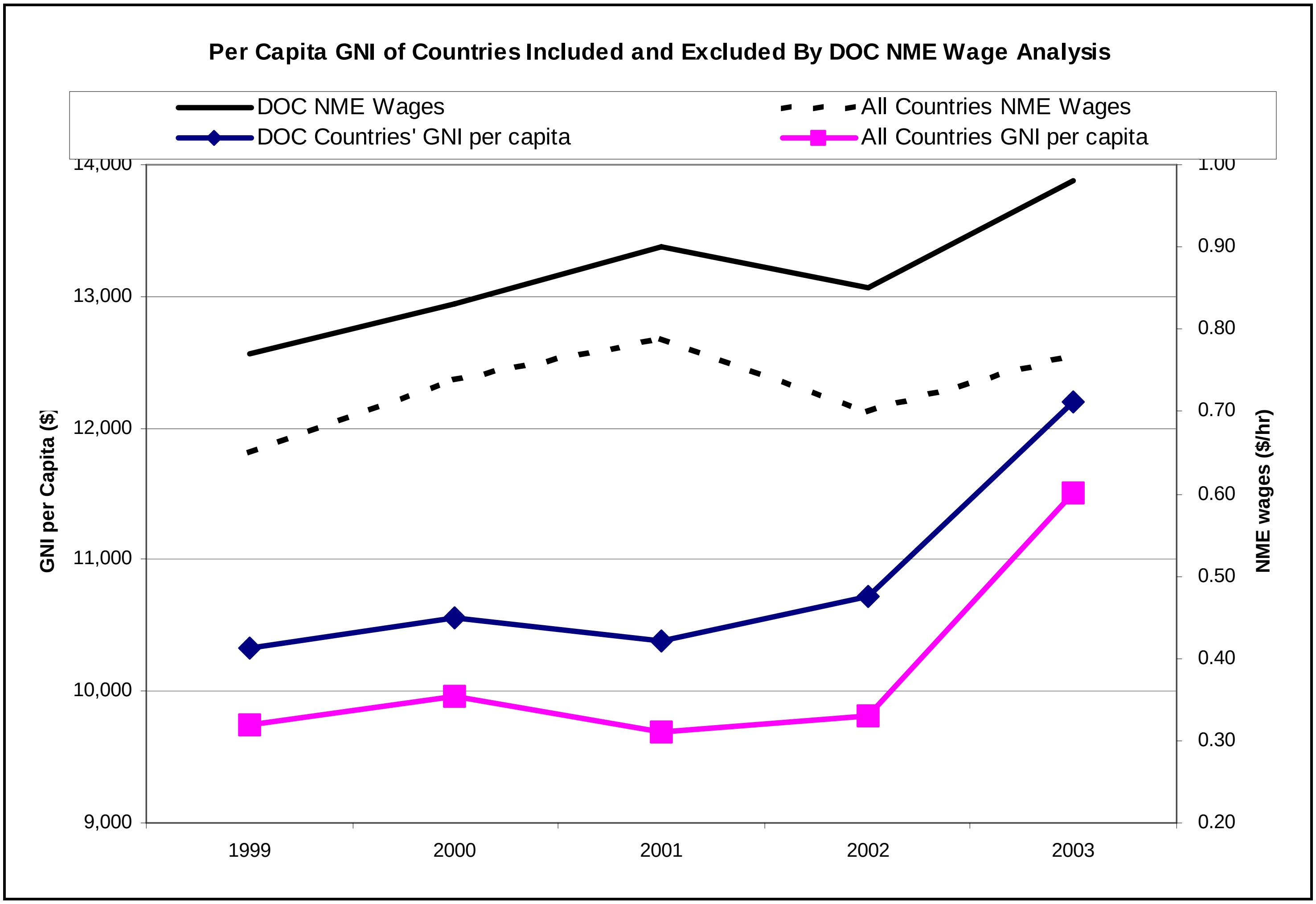
	Y-Intercept	GNI-Coefficient*	China Wage Rate
1999, Commerce Subset	.398	.000475	0.77
1999, All Countries	.301	.000451	0.65
2000, Commerce Subset	.462	.000432	0.83
2000, All Countries	.379	.000429	0.74
2001, Commerce Subset	.512	.000437	0.90
2001, All Countries	.408	.000427	0.79
2002, Commerce Subset	.392	.000481	0.85
2002, All Countries	.246	.000473	0.70
2003, Commerce Subset	.411	.000515	0.98
2003, All Countries	.210	.000508	0.77

* Statistically significant at the 99.99 percent confidence level.

The wage rate calculated by the DOC is consistently higher than the wage rate that would result if the arbitrarily-excluded countries had been properly incorporated into the regression calculation, as shown below:


Comparison of China NME Wage Calculations
DOC
Total
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
$/hr
1999
2000
2001
2002
2003

It is noteworthy that the relationship of these two lines mirrors closely the relationship between the average GNI of the countries the DOC included, versus the GNI of the countries arbitrarily excluded by the Department, as illustrated in the following graph:



The top two lines represent the wage rate for China calculated by the DOC using only a subset of available countries' data, and the wage rate recalculated using all available countries' data, respectively. The difference between these two series is relatively stable. The bottom two lines represent the average per-capita GNI of the countries used by the DOC, versus the average GNI of all available countries. As with the wage rate lines, these two series differ in a relatively stable way, rising and falling in tandem.

As this chart demonstrates, the relative relationship between the GNI of the selected countries and the resulting wage rate calculated for China is apparent to the naked eye. The fact that the Department has systematically and consistently excluded lower GNI countries from its analysis has resulted in correspondingly systematic and consistent overstatement of the expected wage rate for China since at least 1999. Mr. Klett's analysis takes this observation one step further, proving mathematically that the difference between the Y-intercepts of the regression calculation using the DOC subset of countries versus all available countries' data[15] is entirely due to the difference in the average per-capita GNIs of the countries included. *See*, Klett Opinion at 12 ("This proves that the difference in the estimated wage rates between that for all 75 countries, and that for the subset of 52 countries relied on by Commerce is caused by the differences in the average wage rates and per-capita GNI for the two countries in the two datasets").

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[15] Excluding countries that fail to meet the Department's additional selection criteria.

3. Eliminating Higher Wage Countries From the Regression Analysis Would Comply With The Statute and Reduce The Distortions

Mr. Klett's analysis also establishes the demonstrable numerical distortion on China's wage rate due to the inclusion of countries in the regression analysis which are not comparable to China, in contravention of the U.S. statute. The five countries designated by the Department as economically comparable to China within the context of the *Furniture* investigation, for example, fall within the World Bank's groupings for "low income" and "lower-middle" income.[16] The GNI for the "upper middle income" and "high income" countries are stratospherically higher than the "low" and "lower-middle" income countries. See, e.g., Klett Opinion at 9 ("low" and "lower-middle" income countries' GNI is $1,515 versus $16,468 for "upper-middle" and "high-income" countries).

This has a direct impact on the result for China that cannot be overstated. If the Department eliminates the "high income" and "upper middle income" countries from the regression, the resulting wage rate for China is **$0.66**/hour. *See*, Exhibit A at Attachment 9. The per-capita GNI coefficient for this regression, on which this labor rate is based, is statistically significant at the 99.99% confidence level.

What this demonstrates is that the omission of additional low-income countries from the Department's starting dataset, as well as the inclusion of high wage countries, has a measurable and demonstrable effect on the resulting wage rate for China. Under the DOC's calculation, the result is **$0.98**/hour, with a Y-intercept of **0.410**. Adding in all the countries which the Department arbitrarily excluded (regardless of income level,

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[16] *See*, Memorandum from Jon Freed to The File, Antidumping Investigation of Wooden Bedroom Furniture from the People's Republic of China: Selection of Surrogate Country (March 8, 2004). *See also*, Exhibit A, Attachment 5.

satisfying the Department's own country-selection criteria, and with 2003 per-capita GNI data available from the World Bank) lowers the wage rate to **$0.77**/hour (demonstrating the distortion of the exclusion of countries, which on average are lower-wage), with a Y-intercept of **0.210**. Filtering the dataset to either exclude the high and upper middle income wage countries, in compliance with the statute, lowers the result for China even further, to **$0.66**/hour, respectively, with a Y-intercept of **0.185**.

This analysis, summarized in the table below, establishes the numerical distortion caused by the DOC's exclusion of the 23 countries, and unlawful inclusion of countries which are not economically comparable to China.

Table 1: Distortion on Wage Rate Result Caused By Failing to Use All Available Data and Including Non-Comparable Countries

	"A"	**"B"**	**"C"**
	All ILO Countries Meeting DOC Criteria, Excluding "High" and "Upper Middle Income" Countries	**All 75 Countries**	**DOC Sample 2003 Calculation (52 Country Arbitrarily Selected Subset)**
Y-Intercept	0.185	0.210	0.410
Difference from "A"	n/a	**13.51%**	**121.62%**

By limiting the dataset to less than the full range of countries available, and then including in that dataset countries which are not economically comparable, the Department's methodology shifts the Y-intercept upwards by **121%**.[17]

The issues of the Department's improper limitation of the wage data subset and inclusion of countries not economically comparable with China were raised by the

[17] Exhibit A, Attachment 8 shows the upwards parallel shift in the regression line to a higher Y-intercept caused by the DOC's arbitrary exclusion of the additional countries in the initial extract of data from the ILO.

Chinese respondents in *Furniture*, *Shrimp* and others before the Department. The Department now has the opportunity, in the context of this public comment proceeding, to fully and meaningfully consider the arguments raised in those cases, without the time limits that constricted the Department's earlier consideration.

4. Applying A Modified Least Squares Analysis Would Limit Distortions Due to Differences In the Independence of Wage and Income Variables Within the Cross Sectional Dataset Being Analyzed by the Department

There is an additional bias not accounted for in the Department's regression calculation. The Department's regulation does not specify that the regression calculation must be an ordinary least squares (OLS) calculation. According to Mr. Klett, an OLS regression methodology is not the best regression technique when a dataset reflects an absence of homogeneity of the disturbance terms (or "heteroscedasticity") which indicates that the relationship between wages and per-capita income for low-wage countries may be measurably different than for higher-wage countries. Klett Opinion at 14. This potential problem is most likely to exist with a cross-sectional dataset. The wage rate dataset used by the Department is a cross sectional dataset (*i.e.*, as compared to a time-series dataset), since it includes data for one year (2003) for two variables (wages and per-capita GNI) for a cross-section of countries spread across a large spectrum of points (*i.e.*, countries from the sub-$600 per-capita GNI range, such as Pakistan, and India, all the way to countries such as Norway and Switzerland with per-capita GNIs of more than $40,000 -- nearly 7,000% higher).

This distortion can be seen with the naked eye in the graph included on the Department's website. That graph, "2003 GNI, USD per Annum, current (x) Line Fit Plot" shows that the countries located toward the Y-X intersection at the zero point are tightly clustered around the regression line, while there is more dispersion away from the regression line for the higher-wage, higher-income countries.

Where a cross sectional dataset has these kinds of deviances, this is evidence that the dataset may have "Heteroscedastic" properties. Figure 11.6 of the Gujarati econometric text (see Exhibit A, Attachment 14 at page 365) illustrates how differences from the regression line (measured by the character *û*) measure the amount of heteroscedasticity. The DOC's diagram of the wage rates scattergram and the regression line looks strikingly similar to figure 11.6 of the Gujarati text, with both having increased dispersion from the regression line further away from the X-Y intercept.

In these circumstances, and as confirmed by Mr. Klett and the Gujarati text, an OLS regression analysis is not the most accurate regression formula. On the contrary, as stated by Gujarati, “If we persist in using the usual testing procedures despite heteroscedasticity, <u>whatever conclusions we draw or inferences we make may be very misleading</u>.” *See*, Exhibit A, Attachment 14 at 366 (emphasis added). Rather, there is a modified least squares regression calculation, called a "Generalized Least Squares" regression, which measures and accounts for differences within a cross sectional dataset, by properly weighting each datapoint according to its relative level of heteroscedasticity. The OLS method, on the other hand, improperly disregards the plain fact that the datapoints closer to the X-Y intercept are clustered more closely around the regression line.

The SAS programming language includes a Generalized Least Squares calculation function, which applies the GARCH (“Generalized Autoregressive

Conditional Heteroscedasticity") method of least squares regression. Thus, the Department is able to correct for the distortion in the data due to heteroscedasticity.

The "ARCHTEST" function in SAS shows that the 52-country dataset does suffer from heteroscedasticity. *See*, Klett Opinion at 15 and Attachment 16 thereto. Under this condition, using the DOC's 52-country dataset and applying the GLS regression methodology included with the SAS programming software results in an estimated wage rate for China of **$0.84**/hour, rather than the **$0.98** under the OLS method. *See* Klett Opinion at 11. This establishes that there are distortions in using the OLS method due to differences in the independence of the wage and income variables within the cross section (*i.e.*, a different relationship for higher- versus lower-wage countries). The GLS method measures and accounts for these differences in its estimates.[18]

Failing to account for these distortions would not lead to the most accurate calculation of the NME wage rates. As Mr. Klett stated: "Using only an arbitrarily-chosen subset of countries, when data for other countries are available, does not yield a representative wage/per-capita GNI relationship." Exhibit A at 16. The Department's use of only a subset of the countries for which data are available does not yield a statistically valid estimate of the relationship between wage and per-capita GNI for all countries for which data are available. Mr. Klett concluded: "using the 2003 wage and GNI data for the subset of available countries selected by Commerce versus all countries for which data are available yields a different, and <u>distorted result</u>." *Id*. at 16 (emphasis added). Furthermore, failing to further account for demonstrable and numerically

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[18] Exhibit A, Attachment 16 provides both the test results for heteroscedasticity for the DOC's 52-country dataset ("ARCHTEST"), and the GLS estimates for this same dataset (GARCH procedure). The Y-intercept calculated using the GLS method is 0.2722. Therefore, the resulting China wage rate is: China Wage = Y-Intercept + (GNI-coefficient * China per capita GNI), or 0.2722 + (0.00052 * 1100) = **$0.84**.

measurable distortions due to the inclusion of (1) high wage countries in the mix, and (2) different relationships between wages and income at different income levels in the cross-sectional dataset does not accomplish the Department's goal of calculating dumping margins as accurately as possible.

IV. CONCLUSION

It has now been almost nine months since the final determination in *Furniture*. The Department admitted in that case that the methodology may need review, yet it has only begun such a generalized review now, after the Court ordered the remand in the *Furniture* appeals. In the context of the *Furniture* remand, which the Department in fact requested, the Department has preliminarily conceded that the November 2004 calculation (of $0.93/hour) was wrong and must be corrected.

MOFCOM submits that the Sample 2003 calculation is also flawed, for the reasons stated herein. Mr. Klett's findings indicate that the Department's calculations have "systematically overstate{d} the estimated wage rates for NMEs in all years where such calculations are made." For the 2003 data, that distortion inflated the Y-intercept of the regression calculation by **121%**.

The distortion for the past five years is similar and highly disturbing to the Chinese Government. For at least five years, Chinese companies have been subjected to an estimated wage rate calculation that was consistently and systematically overstated in every year, as shown below:

	A	B	(A-B)/B
	DOC Subset	All Available (and Qualifying) Countries	Increase Due to Use of Arbitrary Subset Versus All Available Data
1999	0.77	0.65	18.46%
2000	0.83	0.74	12.16%
2001	0.90	0.79	13.92%
2002	0.85	0.70	21.43%
2003	0.98	0.77	27.27%

This systematic overstatement of the labor rate for China may have been outcome determinative for Chinese companies having low final margins during this period. In other words, the Department's past practice in this regard may have improperly resulted in an affirmative finding of dumping as to individual Chinese companies where a fair calculation of the labor rate, which did not arbitrarily exclude countries, could have resulted in a negative finding.

Now that this most serious issue is being addressed formerly by the Government of the People's Republic of China for the first time, we respectfully request that the Department correct for the distortions in its methodology identified herein, so that further inflation of the dumping margins in cases against Chinese companies can be avoided.

Specifically, the Department should value China's labor factor of production using, (1) India's wage rate only, or (2) an average wage rate of the five countries designated as comparable by the Department in the surrogate country selection memoranda. In the event the Department continues to apply the regression calculation, then the Department should not exclude any countries from the initial extraction of data from the ILO, because doing so precludes a calculation of the "global" correlation between wages and national income. Furthermore, once all data is extracted from the

ILO, then the Department should apply its selection criteria, with the addition that countries not economically comparable to China must be excluded in order to avoid valuing China's FOP using data from countries which are not comparable to China, in violation of the statute. Finally, the Department should implement SAS's statistical functions to account and correct for distortions present in a standard least squares regression calculation due to heteroscedacity in the data.

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EXHIBIT A

Report of Daniel W. Klett, Principal
Capital Trade, Incorporated

Department of Commerce NME Wage Methodology—2003 Base Year Sample Results

I. Introduction

I have been retained by Kaye Scholer to provide an opinion on statistical issues related to the Department of Commerce's ("Commerce") proposed non-market-economy ("NME") wage rate methodology for 2003.[1] This report does not address the validity of the conceptual framework of the regression-based analysis for estimating NME wages, but only statistical issues relating to the application of this methodology. My background is included as **Attachment 1** to this report.

Pursuant to 19 CFR 351.408(c)(3), the Department relies on a regression analysis of the observed relationships between wages and per capita gross national income ("GNI") in market economy ("ME") countries to estimate wage rates for NME countries in antidumping duty investigations. This regulation also states that "The calculation will be based on current data, and will be made available to the public." In its response to comments on this proposed change to its methodology for valuing NME wage rates, the Department stated that "In general, we believe that more data is better than less data, and that averaging of multiple data points (or regression analysis) should lead to more accurate results in valuing any factor of production."[2]

In its June 30, 2005 notice inviting comments, Commerce described its methodology, including data sources on which it relies and a prioritization of the parameters for a selection of a

[1] 79 FR 37761 (June 30, 2005).
[2] 62 FR 27367 (May 19, 1997).

wage rate from the International Labor Organization ("ILO") when multiple alternative wage rates are available. Commerce specified the following sources for country-specific data:[3]

(A) For wages, Chapter 5B of the ILO's Yearbook of Labor Statistics for 56 specified countries.

(B) For per-capita GNI, the World Bank.

(C) For CPI and exchange rates, the International Financial Statistics (IFS) of the International Monetary Fund.

Commerce further specified that for wage rates, it would utilize data covering both male and female workers for all industries, if data are reported within five years of the base year (i.e., 1998 data or later would be acceptable for the 2003 base year). If there continue to exist multiple potential wage rates available once these parameters are satisfied, Commerce specified additional parameters for choosing the wage rate.[4] Commerce also stated that it would eliminate "aberrational" wage rate values, which it defined as "values that vary in either direction in the extreme from year to year."

There are five issues addressed below regarding Commerce's proposed methodology for estimating NME wages for the 2003 Base Year. First, there is no basis for Commerce to restrict its analysis to 56 countries, when there exist additional countries where the ILO has reported wage rates that meet satisfy Commerce's specified parameters, and where other contemporaneous data (i.e., per capita GNI and CPI) also are available. Second, the effect of excluding these additional countries is to inflate the wage rate estimate for China. Third, the inclusion of economically uncomparable upper-middle-income and high-wage countries in the

[3] Commerce provided on its website the raw data supporting its analysis. For wages, it relied on data in a spreadsheet downloaded from the ILO's website on June 21, 2005. For per capita GNI, it relied on data in a spreadsheet downloaded from the World Bank's website on June 3, 2005. For consumer price indices (CPI) it relied on data in a spreadsheet downloaded from the International Monetary Fund on June 14, 2005.

[4] These included, for example, a priority for "wage earners" over "employees," and for wage data reported on an hourly basis over daily, weekly, or monthly wages.

regression further inflates the wage rate estimate for China. Fourth, a review of Commerce's wage rate calculations for earlier years (1999-2003) shows that this distortion has been systematic, and therefore, that the proposed methodology will continue to distort wage-rate estimates for China if used for future Base Year wage rate estimates. Fifth, that cross-sectional data is prone to heteroscedasticity of the error terms, with application of a generalized least squares method providing being a better estimating technique than ordinary least squares when this is the case.

II. Commerce Has Arbitrarily Selected a Subset of Market Economy Data

Commerce states in its June 30, 2005 Request for Comments ("Request") that its regression analysis uses "country-specific wage data for 56 countries from Chapter 5B of the International Labor Organization's Yearbook of Labour Statistics." However, Commerce does not explain why it initially restricts its analysis to these 56 countries, when there are 23 additional countries with wage rate data in Chapter 5B from 1998 or later, and for which the World Bank reports 2003 per-capita GNI data.[5] These countries are:[6]

Albania	Indonesia	Malta**
Cambodia	Iran	Mongolia
Czech Republic	Kazakhstan*	Portugal**
Denmark**	Kuwait	Serbia & Montenegro
Fiji**	Latvia	Seychelles**
Hong Kong	Lithuania*	Slovakia
Hungary	Luxembourg**	Uruguay
Iceland	Macedonia	

[5] In downloading wage rate data from Chapter 5B from the ILO website, Commerce explicitly restricted the data to 56 countries by limiting the download with a specification of 56 country codes. (See **Attachment 2**). Commerce did not use data for Dominican Republic, Algeria, or Kenya in its analysis because there were no wage rate data reported by the ILO for 1998 or later. Zimbabwe was not included by Commerce because 2003 per capita GNI data were not available from the World Bank.

[6] See **Attachment 2**. Although wage rate and per-capita GNI data also were available for Bahrain and Gambia, a 2003 consumer price index (CPI) was not available in the IFS to inflate pre-2003 wage rate data.

* Kazakstan received market economy status in 2001, and Lithuania in January 1, 2003. Because the ILO wage rates available for these countries are for 2003, their data should be used in the analysis. Although Estonia also received market economy status in 2003, the latest wage rate available for this country was for 2002.
** These countries have been included by Commerce in previous years for its analysis. See **Attachment 3**.

There is no reason given by Commerce why data for these countries were excluded from the analysis. For example, in notes to its NME wage rate calculation for prior years, Commerce states that "the selection of countries was based upon the *availability of wage data* as reported in the Yearbook of Labor Statistics 2002." {emphasis added}.[7] Explanatory notes were not provided for the 2003 wage calculations on Commerce's website, but this principle (i.e., selection of countries based on availability of ILO wage rate data) was stated in notes in previous years, and there is no apparent reason why it should not continue to apply to 2003 data, particularly given Commerce's position that "more data is better than less data and that averaging of multiple data points (or regression analysis) should lead to more accurate results in valuing any factor of production."[8] This latter point is supported by standard econometric theory, and presumably is why Commerce made this statement in the first place. For example, a standard econometric text states that:

> "As we move from a smaller sample size to a larger one, two things happen: (a) the bias become smaller, and (b) the estimates become less dispersed. . . . If it is at all possible to increase sample size, then we can buy greater reliability by spending more on sampling."[9]

Thus, it appears that the intent of Commerce is to include the complete dataset of wages available from the ILO that also meets its other specified criteria.

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[7] Explanatory notes were not provided for the 2003 wage calculations on Commerce's website, but this principle (i.e., selection of countries based on availability of ILO wage rate data) was stated in notes in all previous years, and there is no apparent reason why it should not continue to apply to 2003 data.
[8] 62 FR 27367 (May 19, 1997).
[9] See Elements of Econometrics, Jan Kmenta, 1971, at 11-13. An unbiased estimator is one where the mean of the sampling distribution is equal to the true value of the parameter to be estimated. Dispersion relates to the variance of the sampling distribution.

Each of the excluded 23 countries meets Commerce's specified selection criteria. **Attachment 4** reports information for these countries obtained from the same sources (ILO, World Bank, IMF) used by Commerce as for the 52 countries on which it relied, and which were extracted by Capital Trade for these comments. As can be seen in this Attachment, each of these 23 countries has wage data for men and women combined (criteria 1), for all industries combined (criteria 2), for either wage earners or employees (criteria 3), reports the type of data measuring unit (criteria 4), and reports the source of the data (criteria 5). Furthermore, data are available for 1998 or later, and the World Bank reports a 2003 per-capita GNI for each of these countries. With regard to meeting the selection criteria, there is no difference between the 52 countries arbitrarily selected by Commerce for its analysis and the 23 countries excluded by Commerce, and Commerce has provided no basis or rationale for their exclusion from its regression analysis. In fact, Commerce has excluded one of the five countries (Indonesia) that is a surrogate country for China in the Furniture reviews, even though data are available for this country.

Commerce gives one possible reason to exclude specific countries even when these criteria are met. This is when wage rates are aberrational, defined as "values that vary in either direction in the extreme from year-to-year." (Request, at 4). However, there is no indication that any of these 23 countries should have been excluded from the analysis due to aberrational wage rate values. The 2003 wage rates for these countries were well within the range of wage rates (on a $/hour basis) for countries within the same income-level grouping as defined by the World Bank,[10] and the 2003 wage rate did not depart significantly (up or down) from previous year wage rates for any particular country.[11] If Commerce had excluded any countries on this basis, it

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[10] See **Attachment 5**.
[11] See **Attachment 6**.

would have been incumbent on it to explain why, as it did for two other countries (Dominican Republic, Algeria, Kenya, and Zimbabwe) that were excluded from the regression analysis. (Request, at 5).

To conclude, there is no apparent reason why Commerce should exclude from its regression analysis the additional 23 countries specified above in its wage rate dataset for Base Year 2003 NME wage rate calculations. All these countries meet the wage rate selection criteria specified by Commerce, and the wages are not aberrational. Considering the Department's position that "more data is better than less data" to support its use of a regression-based methodology, arbitrarily excluding data that meets is specified selection criteria is not only inconsistent with that position, it is also statistically unsound.

III. Exclusion of Data Has Distorted the Results

Exclusion of countries from the analysis for which data are available seriously distorts the results. As shown in the following tabulation, the countries excluded by Commerce are, on average, lower-income and lower-wage countries, although Commerce excluded some countries at all wage and income levels:[12]

	Avg. Hourly Wage	Avg. Per Capita GNI
52 Countries Included	$6.69	$12,197
23 Countries Excluded	$4.61	$9,936

Intuitively, exclusion of these countries would be expected to yield regression estimates that would result in NME wage estimates having an upward distortion. In fact, this is what occurred, as reflected in the following tabulation which includes the key regression result parameters that determine the NME wage estimate:

[12] See **Attachment 5**.

	Y-Intercept	GNI-Coefficient
DOC 52-Country Subset[13]	0.410	0.00051*
All 75 Countries[14]	0.210	0.00051*

* Statistically significant at the 99.99% confidence level.

These estimated parameters determine the linear trend line that runs through the wage/per-capita GNI pairs associated with each country. The Y-intercept is where the linear trend line intercepts the Y axis, and the GNI coefficient reflects the line's slope. These two parameters are used to estimate the wage rate for a NME, given the per-capita GNI associated with that NME. For example, for China the estimate is as follows, using Commerce's estimated results:[15]

China Wage = Y-Intercept + (GNI-coefficient * China per capita GNI)

$0.98 = 0.410 + (0.00051 * 1,100)

By contrast, using all available data that meets Commerce's criteria results in a lower estimated wage, as follows:

$0.77 = 0.21 + (0.00051 * 1,100)

What drives this difference is not the slope of the estimated linear line (which is virtually identical for both estimates), but the <u>intercept</u>. Exclusion from the analysis of countries which have, on average, lower wages and per-capita GNI results in the linear trend line being at a higher point (and parallel to) the regression line that uses all available data. As shown in the first page of **Attachment 8**, the countries excluded by Commerce generally have wage/per-capita

[13] See Draft Results, Exhibit III.

[14] See **Attachment 7**. Note that in both estimates, the statistical significance of the per-capita GNI coefficient is well above 99 percent. The fact that the regression results using 52 countries has a slightly higher R^2 statistic (0.92) than the regression results using 75 countries (0.83) is not a legitimate statistical basis supporting use of the 52-country regression over the 75-country regression. We are aware of no legitimate statistical basis for including/excluding data from a regression analysis to maximize the R^2 statistic on a post-hoc basis.

[15] It also is possible to estimate the NME wage rate using only the GNI-coefficient, by applying this to the difference between per-capita GNI for the NME for which the wage rate is being estimated and the average per-capita GNI for all countries. The results are exactly the same. See **Attachment 7**.

GNI points that are below the estimated regression line based on the subset of countries (52) on which Commerce based its estimates. The second page of **Attachment 8** is a "blowup" of the regression results, but with a focus on countries with wages under $1.00/hour, and with two regression lines. The top regression line is that using the subset of 52 countries on which Commerce relied. The bottom regression line is that using the full set of 75 countries for which data are available.

This distortion will not be restricted to the 2003 Base Year results, but is likely to systematically overstate the estimated wage rates for NMEs in all years where such calculations are made. This is because if Commerce continues to restrict its regression analysis to the 56 arbitrarily-chosen countries, it is systematically excluding countries that, on average, have lower wage rates and per-capita GNI levels.

IV. Inclusion of Countries at Higher Levels of Economic Development Has Distorted the Results

Another distortion to the methodology currently used by Commerce is the inclusion in the regression results of wages and per-capita GNI that differ significantly from those of that of the NMEs for which wages are being estimated. Section 773(c)(4)(A) requires the Department to value the factors of production, including labor hours as specified in Section 773(c)(3)(A), in one or more market economy countries that are "at a level of economic development comparable to that of the nonmarket economy country" and which are "significant producers" of comparable merchandise. 19. U.S.C. § 1677b(c).

All five Market Economy countries designated as economically comparable to China (India, Indonesia, Pakistan, Sri Lanka, and the Philippines) are classified by the World Bank as either "low-income" or "lower-middle-income" economies. (See **Attachment 5**). As shown in the following tabulation, the average per-capita income differs significantly for low-income and lower-middle-income countries as compared to upper-middle-income and high-income countries:

Country Classification	Avg. Per Capita GNI ($)
Low-Income and Lower-Middle-Income (26)	$1,515
Upper-Middle-Income and High-Income (49)	$16,468
Total (75)	$11,504

The structure of these economies differs significantly, and although there may be a positive relationship between wage rates and per-capita GNI, the specific nature of this relationship may differ depending on the wage/income category of the country.

It is appropriate to equate China with the World Bank's classifications, since China falls squarely within the "low" and "lower-middle" income group of countries. The following tabulation, based on 2003 per-capita GNIs (for which wage rates also are available), shows that the subset of "low" and "lower-middle" income countries appropriately includes China, and that the remaining countries' GNI is far above China.[16]

Per-Capita GNI, China	$1,100
Per-Capita GNI, 26 Low-Income and Lower-Middle Income Countries	$1,515
Low-Income and Lower-Middle-Income Countries With GNI > China GNI	17
Low-Income and Lower-Middle-Income Countries With GNI < China GNI	9
Per Capita GNI, 49 Upper-Middle-Income and High-Income Countries	$16,804

Thus, once the Department properly extracts "all available" data, then the data show that limiting the calculation to those countries that are economically comparable to China, based on the World Bank's "low" and "lower middle" income classifications, is appropriate since the average GNI of this group is similar to China, while the remaining countries' GNI is not.[17]

[16] See **Attachment 5** for supporting data.

[17] The Department's selection criteria provide for the elimination of country data that would be unsuitable for use in the regression calculation, for example, because the data are aberrational. Supplementing these criteria to also limit inclusion in the regression only to countries which are economically comparable, based on objective World Bank

A regression analysis applied to these countries yields the following results.[18]

	Y-Intercept	GNI-Coefficient	Wage Estimate
26 Low and Lower-Middle	0.185	.00043*	$0.66/hr.

* Statistically significant at the 99.99% confidence level.

V. Analysis of Commerce's Wage Rate Calculations, 1999 to 2003

A review of Commerce's NME wage rate calculations, and the underlying data, for each of the Base Years from 1999 through 2003 demonstrates that Commerce's estimates have been distorted in past years as well. The following tabulations compare the average wage rates and per-capita GNIs for the countries included and those excluded from Commerce's wage rate regressions, as well as for only those countries classified by the World Bank as being low-income or lower-middle-income.[19]

	Wage Rates For Countries Used in Regression Analysis ($/hr.)		Per-Capita GNI For Countries Used in Regression Analysis ($)	
	DOC-Included	DOC-Excluded	DOC-Included	DOC-Excluded
1999	5.30	3.60	10,324	8,686
2000	5.03	3.95	10,561	8,858
2001	5.05	3.60	10,380	8,374
2002	5.56	3.57	10,726	7,773
2003	6.69	4.61	12,197	9,936

As can be seen in this tabulation, the wages and per-capita GNIs for the market-economy countries used by Commerce for its regressions have been systematically higher than for countries excluded from its regression analysis. The following tabulation compares the

classifications, would not be arbitrary, since it is based on the World Bank's data set and not the Department of Commerce's self-selected data.

[18] **Attachment 9**.

[19] See **Attachment 10** for supporting calculations and documentation. These and other calculations in this section of the report are based on the wage rate and per-capita GNI data used by Commerce for each of these years as reported on its website, and current information for each of these years for additional countries that were excluded by Commerce from its calculations. It is recognized that for prior years, wage rate data available now may not have been available from the ILO at the time the estimates were made by Commerce. The purpose here is not to recommend that past NME wage rates estimates be adjusted (with the exception of 2002, which is still currently under review in litigation), but to show that flaws in Commerce's methodology are not restricted to its 2003 sample estimates.

Commerce regression results for each year (and the estimated wage rate for China) based on the DOC's subset of countries, with the results using the broader set of countries for which data are available.[20]

	Y-Intercept	GNI-Coefficient*	China Wage Rate
1999, Commerce Subset	.398	.000475	0.77
1999, All Countries	.301	.000451	0.65
2000, Commerce Subset	.462	.000432	0.83
2000, All Countries	.379	.000429	0.74
2001, Commerce Subset	.512	.000437	0.90
2001, All Countries	.408	.000427	0.79
2002, Commerce Subset	.392	.000481	0.85
2002, All Countries	.246	.000473	0.70
2003, Commerce Subset	.411	.000515	0.98
2003, All Countries	.210	.000508	0.77

* Statistically significant at the 99.99 percent confidence level.

As shown in this tabulation, there is a systematic difference between the Y-intercepts and lower estimated wage rates for China using a subset of available market economy wage and per-capita GNI data, and the estimates using data for the full set of countries where such data are available. This difference in estimated wage rates is the result of the fact that the subset of countries relied on by Commerce for its estimates are, on average, lower wage-rate and lower per-capita GNI countries, than for the full set of countries for which data are available.

This can be proven numerically by applying a different formula derived from the regression results that does not depend on the Y-Intercept, but rather on the difference between the per-capita GNI of China and the countries on which the regression estimates are based. For

[20] See **Attachments 11** (supporting documentation for wage rate calculations and per-capita GNI for each year), **12** (summary of wage rate and per-capita GNI for all countries used in the regression analysis), and **13** (regression results for all countries). The Commerce results are those on its website for each year, with the exception of 2002 which are the parameters and wage rate as reported in its July 7, 2005 Draft Redetermination for Wooden Bedroom Furniture, which has corrected for certain errors in the 2002 estimates posted on the Commerce website.

example, using 2003 data the following tabulation shows the results using the Commerce formula, and an alternative formula.[21]

	Intercept	GNI-Coefficient	China GNI	Avg. GNI	Avg. Wage
Total 75	.2101	.000508	1,100	11,504	6.05
Commerce 52	.4105	.000515	1,100	12,197	6.69

Standard Formula:

Intercept + (GNI Coefficient * China per capita GNI) = Estimated Wage

Total-75: .2101 + (.000508 * 1,100) = $0.77

DOC-52: .4105 + (.000515 * 1,100) = $0.98

Alternate Formula:

Avg. Wage – (Avg. per capita GNI – China per capita GNI) * GNI Coeff.

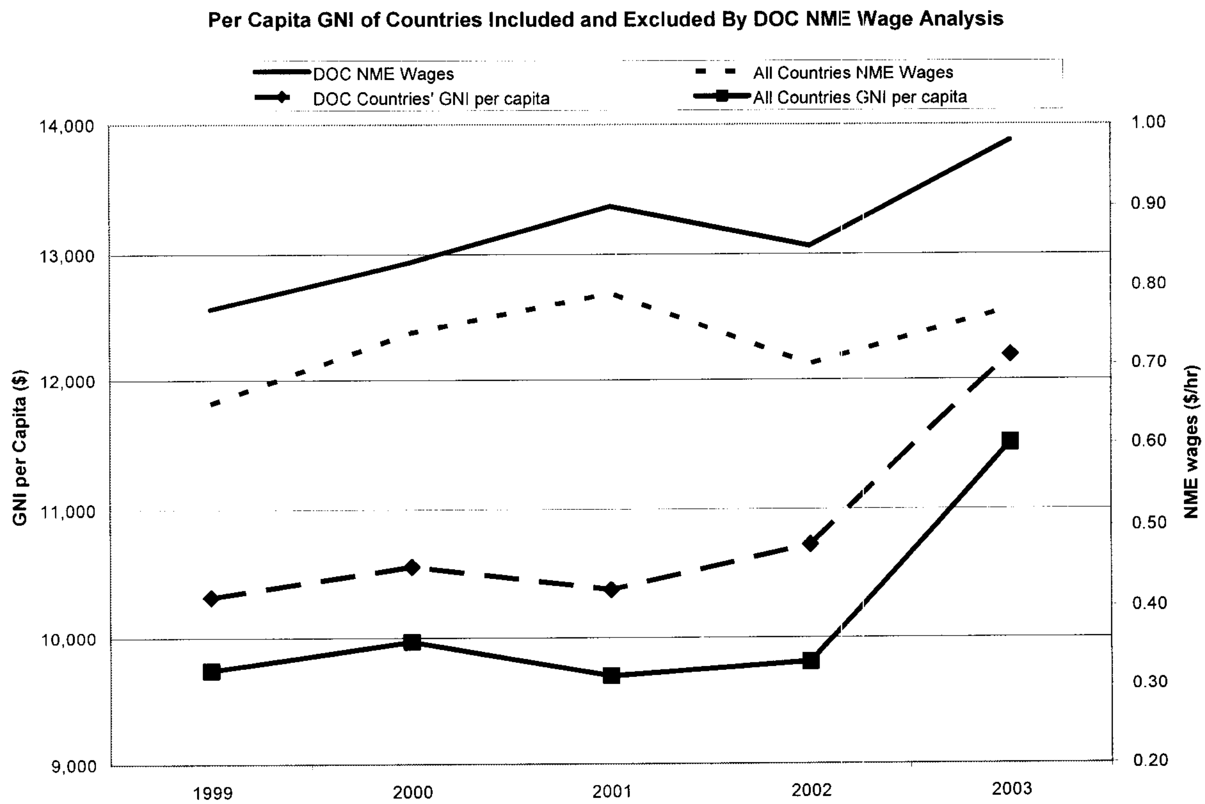
Total-75: 6.05 – (11,504 – 1,100) * .000508 = $0.77

DOC-52: 6.69 – (12,197 – 1,100) * .000515 = $0.98

The exact same result is found without reference to the estimated Y-intercept, but by using only the estimated GNI-coefficient, the average wage for all countries in the dataset, and the difference between the per-capita GNI for all countries in the dataset and that of China.[22] This proves that the difference in the estimated wage rates between that for all 75 countries, and that for the subset of 52 countries relied on by Commerce is caused by the differences in the average wage rates and per-capita GNI for the countries in the two datasets. This can also be seen graphically. (See **Attachment 13**).

[21] Supporting data for the "Total 75" calculations and results are in **Attachments 11, 12,** and **13**. The Commerce regression results and supporting data for 2003 are on its website, http://ia.ita.doc.gov/wages/03wages/03wages.html.

[22] If these calculations are done on a spreadsheet, the results are identical to multiple decimal places.



VI. Cross-Sectional Data are Prone to Heteroscedasticity

It is well known, particularly under scenarios such as this, that regression results of cross-sectional data may suffer from "heteroscedasticity." When this is the case, use of the ordinary least-squares ("OLS") estimating technique (which is what is being used by Commerce through Excel) is not the best estimating method, as is the case when the error variance is the same for all observations (i.e., is "homoscedastic").[23] Intuitively, what this means is that at different levels of per-capita GNI (the independent variable in this case), there can be different levels of variance of the wage rates (the dependent variable in this case). An example given by Gujarati relates savings (dependent variable) to income (independent variable). Heteroscedasticity may be

[23] See, e.g., Basic Econometrics, Damodar N. Gujarati, Third Edition, Chapter 11. (Excerpts at **Attachment 14**). See also, SAS documentation from its website and SAS/ETS User's Guide. (Excerpts at **Attachment 15**) : "One of the classical assumptions of the ordinary regression model is that the disturbance variance is constant, or homogeneous, across observations. If this assumption is violated, the errors are said to be 'heteroscedastic.' Heteroscedasticity often arises in the analysis of cross-sectional data."

present because as incomes rise, "savings on the average also increase," but there may be more variability in the savings rates of high-income families.[24]

A review of the scatter diagram of observations indicates that there may be more variance in wage rates as per-capita income increases. (**Attachment 9**). There are standard statistical tests for the existence of heteroscedasticity.[25] A standard method using SAS/ETS to test for the existence of heterogeneity is to use the "ARCHTEST" option under the "AUTOREG" procedure.[26] AUTOREG normally estimates a regression using OLS, and the OLS results using AUTOREG are the same as the results generated by Commerce using Excel. ARCHTEST tests for heteroscedasticity by generating Q-statistics for changes in variance, as well as Lagrange multiplier tests. The "p" (probability) values for the test statistics indicate the probability that heteroscedasticity exists.[27]

When there is an indication that heteroscedasticity exists, a better estimating procedure is Generalized Least Squares ("GLS") rather than OLS. This is because GLS uses the information in the data that variances are not constant. As described by Gujarati:[28]

> "If we were to regress per-employee compensation on the size of employment, we would like to make use of the knowledge that there is considerable interclass variability in earnings. Ideally, we would like to devise the estimating scheme in such a manner that observations coming from populations with greater variability are given less weight than those coming from populations with smaller variability.
>
> Unfortunately, the usual OLS method does not follow this strategy and therefore does not make use of the 'information' contained in the unequal variability of the dependent variable Y, say, employee compensation of Fig. II.1: its assigns equal weight or importance to each observation. But a method of estimation, known as generalized least squares (GLS), takes such information into account explicitly and is therefore capable of producing estimators that are BLUE." {best, linear, unbiased, estimators}

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[24] Id., at 357. One possible reason is that as incomes increase, a higher percentage of income is discretionary, leading to higher variances in savings rates at higher income levels.
[25] See Basic Econometrics, at 367-380.
[26] See **Attachment 15**, which includes SAS code for this procedure. Commerce uses SAS as its statistical package in antidumping proceedings.
[27] When a p-value is, for example, 0.01, then the probability that heteroscedasticity exists is 99%.
[28] Basic Econometrics, at 362. (**Attachment 14**).

Gujarati states that:[29]

> **"In short, if we persist in using the usual testing procedures despite heteroscedasticity, whatever conclusions we draw or inferences we make may be very misleading."**

If heteroscedasticity is present, then GLS is a better estimating method. One method available in SAS/ETS is the generalized autoregressive conditional heteroscedasticity (GARCH) model, which is an option under the AUTOREG procedure.[30]

For these reasons, we also have used SAS to test each of these two datasets for heteroscedasticity, and to apply the generalized least squares (GLS) regression method. The results show that for the dataset of all 75 countries, there is a low probability of heteroscedasticity, and the OLS and GLS methods yield the same Y-intercept and GNI-coefficient estimates. For the dataset of low-income and lower-middle-income countries, there is a higher probability of heteroscedasticity, so the GLS estimates are more reliable. However, the GLS estimates also yield a wage estimate for China of $0.66/hour. (**Attachment 16**).

We have tested the data relied upon by Commerce for the 52-country subset of available data for heteroscedasticity, using the ARCHTEST option. The results (including the log and output) are included in **Attachment 16**. They show that at various GNI levels (i.e., "windows" 7 through 12) that there is a higher probability of heteroscedasticity. For this reason, the GLS method (using the GARCH model in SAS) was used rather than OLS.[31] The results also are shown in **Attachment 16**. The GLS estimates yield similar estimates, with the exception being that the Y-intercept is about $0.14 lower.

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[29] Id., at 366 (emphasis in original).

[30] <u>See</u> **Attachment 15**.

[31] In fact, when the dataset are cross sectional with a heterogeneous group of countries, one would expect, *a priori*, heteroscedasticity in the error terms. See <u>Basic Econometrics</u>, at 380. (**Attachment 14**). For this reason, it would be reasonable to apply the GLS regression method as the standard practice, without even testing for the existence of heteroscedasticity. For example, when there is no evidence of heteroscedasticity, the OLS and GLS methods effectively yield the same results (see below).

VII. Conclusion

Commerce's methodology purports to calculate a worldwide relationship between wages and GNI, and it has enumerated criteria for which countries to include in its analysis. Yet Commerce has arbitrarily restricted its regression analysis to 56 countries, and has provided no explanation or justification for why other countries for which data are available, and which satisfy its selection-criteria, are excluded. Using only an arbitrarily-chosen subset of countries, when data for other countries are available, does not yield a representative wage/per-capita GNI relationship. As demonstrated above, using the 2003 wage and GNI data for the subset of available countries selected by Commerce versus all countries for which data are available yields a different, and distorted result. Since the countries arbitrarily excluded by the Department in the data extract from the ILO are, on average, lower-wage, lower-GNI countries, the resulting distortion in the estimated wage rate for China is mathematically measurable.

If Commerce continues to base its NME wage-rate calculations using a regression-based analysis, it must revise the calculations in its 2003 Sample Calculation as follows. From a statistical validity perspective, Commerce should use data from all ME countries that satisfy its own specified selection criteria, and for which 2003 per-capita GNI data are available from the World Bank's World Development Indicators. However, there also is the legal requirement that the analysis be based on market economy countries that are "at a level of economic development comparable to that of the nonmarket economy country" and in this context, the regression analysis should be restricted to "low-income" and "lower-middle-income countries." These classifications, defined by the World Bank, squarely include China. In contrast, the remaining countries' average GNI is 16 times higher than China's. Use of the World Bank "low" and "lower-middle" income classifications (provided the results are statistically significant) would eliminate the arbitrariness from the wage rate calculation, since they are both published by the World Bank (rather than arbitrarily selected by the Department or any party) and would limit the resulting calculation only to economically comparable countries, in accordance with the dumping statute.

Daniel W. Klett

7/29/05
Date

List of Attachments

Attachment 1	Daniel Klett Experience
Attachment 2	Commerce (5/25/05) and Capital Trade (6/30/05) Extractions of Wages from ILO Website (Excerpts)
Attachment 3	History of Countries Used by Commerce for Regression Analyses
Attachment 4	Selection Criteria for Excluded Countries, and Per-Capita GNI.
Attachment 5	2003 Wage, GNI, for 75 Market Economy Countries, and Supporting Data
Attachment 6	Historical Wage Rates (1998-2003) for 23 Excluded Countries
Attachment 7	Regression Results for 75 Countries, 2003 Data
Attachment 8	Graph of Regression Results
Attachment 9	Regression Results for Low-Income and Lower-Middle-Income Countries
Attachment 10	Wage and Per-Capita GNI Calculations for 1999 to 2003, Commerce Subset of Countries and All Countries
Attachment 11	Supporting Calculations for Wage Rates for Excluded Countries, 1999 to 2003
Attachment 12	Summary of Wage Rate and Per-Capita GNI Data Used in Regression Analyses, 1999 to 2003
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Attachment 14	Excerpts from Basic Econometrics
Attachment 15	Excerpts from SAS Documentation
Attachment 16	SAS Log and Output—OLS and GLS Results

Attachment 1

DANIEL W. KLETT

EDUCATION

1985, M.A., Economics, Georgetown University
1976, B.A., Economics, College of the Holy Cross

EXPERIENCE

Mr. Klett is a principal with Capital Trade, Incorporated. His background is in international economics and trade regulation, with specific expertise in assessing the economic impact of imports on U.S. industries and consumers. He has participated in studies involving U.S. export control regulations, direct foreign investment in the United States, and financial analysis of the member companies of an international consortium.

Economic Analysis

Mr. Klett's experience in economic analysis of international trade issues includes:

- Analysis of impact of imports on competing U.S. industry, including use of existing economic models, econometric analysis of time series data, and testimony
- Estimation of impact of trade restrictions on consumers
- Economic analysis relating to domestic industry issues in Section 337 investigations at the U.S. International Trade Commission, and expert testimony
- Statistical analysis to support arguments made to the Department of Commerce in antidumping investigations

Case Experience - U.S. International Trade Commission:

- Framing Stock from the UK
- Softwood Lumber from Canada
- Uranium
- Flat Panel Displays from Japan
- Cement (Japan, Mexico, Venezuela)
- Industrial Nitrocellulose
- Atlantic Salmon from Norway
- Silicon Metal from Brazil
- Aspheric Ophthalmoscopy Lenses from Japan
- Honey from China
- Pencils from China
- Bulk Diltiazem (Section 337)

Case Experience - U.S. International Trade Commission (cont.):

- Polyvinyl Alcohol (Japan, Korea, Taiwan, PRC)
- Salinomycin Biomass (Section 337)
- Rebar from Turkey
- Pasta from Italy and Turkey
- Stainless Steel Wire Rod
- Wheat Gluten (Section 201)
- EEPROMs (Section 337)
- Titanium Sponge (Changed Circumstance Review)
- Cut-to-Length Carbon Steel Plate
- Ferrosilicon (Changed Circumstance Review)
- Roller Chains from Japan (Sunset Review)
- Color Picture Tubes (Sunset Review)
- Silicon Metal (Sunset Review)
- Various carbon steel products
- Table Grapes from Chile
- Steel Wire Rope
- Ammonium Nitrate (Russia, Ukraine)
- Large Diameter Line Pipe
- Low-Enriched Uranium
- Automotive Replacement Glass from China
- Oil Country Tubular Goods
- DRAMs from Korea
- Urea Ammonium Nitrate
- Shrimp
- Outboard Motors from Japan
- Artists Canvas from China
- Diamond Sawblades from China and Korea

Case Experience - U.S. Department of Commerce:

- Industrial Nitrocellulose from Seven Countries
- Atlantic Salmon from Norway
- Kiwifruit from New Zealand
- Man-Made Fiber Sweaters from Korea
- Potassium Permanganate from Spain and China
- Aspheric Ophthalmoscopy Lenses from Japan
- Flat-Rolled Carbon Steel Products from various countries
- Oil Country Tubular Goods from various countries
- Stainless Steel Bar from India
- Sebacic Acid from China

Other Projects

Mr. Klett has participated in other international trade-related projects, including:

- Consumer cost study for Japanese semiconductor companies involved in an EC antidumping proceeding.
- Analysis of the impact of U.S. national security export controls on the international business strategies of U.S. high-technology companies.
- Assistance to a Swiss manufacturer in assessing the feasibility of setting up manufacturing facilities in the United States, and site location.
- Analysis of the financial condition of Airbus members, in the context of state support and commercial conditions.
- Section 301 investigation involving modified wheat starch from the EU (on behalf of EU grain industry).

Prior Experience

Prior to forming Capital Trade, Incorporated, Mr. Klett was a Vice President with ICF Consulting Associates (1990-92), and a supervisor at Coopers & Lybrand (1987-90).

From 1979 to 1987, Mr. Klett was an economist at the U.S. International Trade Commission, first in the Office of Economics (1979-1986) and then as the economic advisor to four Administrative Law Judges (1986-1987) involved in Section 337 proceedings.

From 1977 to 1979, Mr. Klett served as a Peace Corps volunteer in Sierra Leone, teaching economics at the high school junior to introductory university levels.

PROFESSIONAL AFFILIATIONS

American Economic Association

PUBLICATIONS AND CONFERENCES

"The U.S. Tariff Act, Section 337: Off-Shore Assembly and the Domestic Industry," Journal of World Trade Law, May-June 1986.

"Price Sensitivity and ITC Injury Determinations: A Matter of Definition," (with T. Schneider) Journal of World Trade, April 1994.

"Proposed Changes Concerning Import Duties and Domestic Indirect Tax Rebates--Conformity to the GATT, and Benefits to the Peruvian Export Sector," Presented at Foro Internacional Sobre Devolucion de Impuestos y Drawback a Las Exportaciones, Lima, Peru, August, 1994.

Attachment 2

INTERNATIONAL LABOUR ORGANIZATION Geneva
LABORSTA Labour Statistics Database

Selection:
Note: Extraction Limited to 56 Country Codes --->

DEPARTMENT OF COMMERCE EXTRACTION OF DATA FROM ILO WEBSITE

years: 1994-2003
country(ies): AR AT AU BE BG BO BR BW CA CH CL CO CR DE DO DZ EC EG ES FI FR GB GR GT HR IE IL IN JO JP KE KR LK MU MX MY NI NL NO NZ PA PE PH PK PL PY SE SG SI SV TH TR TT US ZA ZW
table: 5B
extracted on 24/05/2005.

For notes, please refer to the HTML table

COUNTRY	CODE COUNTRY	CURRENCY	TYPE OF DATA	WORKER COVERAGE	SEX	CODE TABLE	SUB-CLASSIFICATION	D1998	D1999	D2000	D2001	D2002	D2003
Algeria	DZ	Dinars	Earnings per month	Employees	Men and Women	5B	Total						
Argentina	AR	Pesos	Earnings per hour	Wage earners	Men and Women	5B	Total	4.12	4.16	4.23	4.29		
Australia	AU	Dollars	Earnings per hour	Employees	Men and Women	5B	Total	17.38		18.16		20.45	
Austria	AT	Euros	Earnings per month	Wage earners	Men and Women	5B	Total			1973	2046		
Belgium	BE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total		11				
Bolivia	BO	Bolivianos	Wage rates per month	Employees	Men and Women	5B	Total	972	1055	1120			
Botswana	BW	Pula	Earnings per month	Employees	Men and Women	5B	Total	695	785	783	891	889	944
Brazil	BR	Reais	Earnings per month	Employees	Men and Women	5B	Total	717.36	752.21	763.11	844.61	901.85	
Bulgaria	BG	Leva	Earnings per month	Employees	Men and Women	5B	Total	194612	203	219	227	244	
Canada	CA	Dollars	Earnings per hour	Wage earners	Men and Women	5B	Total	17.59	17.82	18.29	18.59	19.1	19.7
Chile	CL	Pesos	Earnings per month	Employees	Men and Women	5B	Total	200773	203540	208257	213394	218740	221860
Colombia	CO	Pesos	Earnings per month	Employees	Men and Women	5B	Total					353590	442510
Costa Rica	CR	Colones	Earnings per month	Employees	Men and Women	5B	Total	85899	97774.5	108777	128207		
Croatia	HR	Kunas	Earnings per month	Employees	Men and Women	5B	Total	3681	3869	4100	4465	4794	5043
Dominican Republic	DO	Pesos	Earnings per hour	Total employment	Men and Women	5B	Total						
Ecuador	EC	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total						
Ecuador	EC	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total	6119	8556.2	0.81	1.27		
Egypt	EG	Pounds	Earnings per week	Wage earners	Men and Women	5B	Total	107	121	125	136	147	
El Salvador	SV	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total	10.27	10.68	10.09		1.21	1.25
Finland	FI	Euros	Earnings per month	Employees	Men and Women	5B	Total	12054	12510	13124	2275	2357	
France	FR	Euros	Earnings per month	Employees	Men and Women	5B	Total		1459	1477	1507	1563	
Germany	DE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total	26.78	27.53	27.78	14.42	14.72	15.09
Greece	GR	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total	1539.76					
Guatemala	GT	Quetzales	Earnings per month	Employees	Men and Women	5B	Total	1541.03	1602.25	1655.25	1732.27	1837.32	
India	IN	Rupees	Earnings per month	Wage earners	Men and Women	5B	Total	1211.1	1548.5	1280.8	1893.2		
Ireland	IE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total		9.79	10.4	11.47	12.29	12.96
Israel	IL	New Shekels	Earnings per month	Employees	Men and Women	5B	Total				9088	9179	9218
Japan	JP	Yen	Earnings per month	Employees	Men and Women	5B	Total	289600	291100	293100	297500	296400	296500
Jordan	JO	Dinars	Earnings per month	Employees	Men and Women	5B	Total	198.5	172	189	185		
Kenya	KE	Shillings	Earnings per month	Employees	Men and Women	5B	Total						
Korea, Republic of	KR	Won	Earnings per month	Employees	Men and Women	5B	Total	1284.5	1475.5	1601.5	1702.4	1907	2075
Malaysia	MY	Ringgit	Earnings per month	Employees	Men and Women	5B	Total			1388	1531		
Mauritius	MU	Rupees	Earnings per month	Employees	Men and Women	5B	Total		5142	5544	5856	6155	6668
Mexico	MX	Nuevos Pesos	Earnings per hour	Wage earners	Men and Women	5B	Total	14.84	17.82	20.77	23.53	25.19	26.85
Netherlands	NL	Euros	Earnings per hour	Employees	Men and Women	5B	Total	32.02	33.32	34.42			
New Zealand	NZ	Dollars	Earnings per hour	Employees	Men and Women	5B	Total			16.99	17.39	18	18.82
Nicaragua	NI	Córdobas	Earnings per hour	Employees	Men and Women	5B	Total	12	12	13.24	13.45	13.46	
Norway	NO	Kroner	Earnings per month	Employees	Men and Women	5B	Total	21417	22441	23388	24426	25991	26944
Pakistan	PK	Rupees	Earnings per month	Employees	Men and Women	5B	Total	3705.96	2865.76	2980.97	3002.23	4113.74	
Panama	PA	Balboas	Earnings per hour	Total employment	Men and Women	5B	Total					1.8	1.7
Paraguay	PY	Guaranies	Earnings per month	Employees	Men and Women	5B	Total			813765	639988	739738	816428
Peru	PE	Nuevos Soles	Wage rates per day	Wage earners	Men and Women	5B	Total	24.93	25.56	27.23	27.12	28.07	27.17
Philippines	PH	Pesos	Earnings per month	Employees	Men and Women	5B	Total	6400	6900	7300			
Poland	PL	New Zlotys	Earnings per month	Employees	Men and Women	5B	Total	1164.4	1598.89	1756.43	1866.51	1911.52	2034.03
Singapore	SG	Dollars	Earnings per month	Employees	Men and Women	5B	Total	2716	2803	3036	3117	3154	3265
Slovenia	SI	Tolars	Earnings per month	Employees	Men and Women	5B	Total	132080	144110	161296	178596	196220	211060
South Africa	ZA	Rand	Earnings per month	Employees	Men and Women	5B	Total	3803	4018	4323	4701	5197	
Spain	ES	Euros	Earnings per hour	Employees	Men and Women	5B	Total		9.75	10.04	10.46	10.97	11.5
Sri Lanka	LK	Rupees	Earnings per hour	Wage earners	Men and Women	5B	Total	20.34	22.03	24.86	27.1	31.93	33.21
Sweden	SE	Kronor	Earnings per hour	Wage earners	Men and Women	5B	Total	105.07	106.85	111.3	114.9	118.2	122
Switzerland	CH	Francs	Earnings per month	Employees	Men and Women	5B	Total	5717		5862		6155	
Thailand	TH	Baht	Wage rates per month	Employees	Men and Women	5B	Total				6064.6		
Trinidad and Tobago	TT	Dollars	Earnings per week	Employees	Men and Women	5B	Total	908.73	938.82	1170.12	1161.15	1161.63	
Turkey	TR	Liras	Earnings per hour	Employees	Men and Women	5B	Total	781.6	1397	2163.3	2917.6		
United Kingdom	GB	Pounds	Earnings per hour	Employees	Men and Women	5B	Total	9.17	9.55	9.96	10.53	11.02	11.43
United States	US	Dollars	Earnings per hour	Wage earners	Men and Women	5B	Total	13.49	13.9	14.37	14.83	15.3	
Zimbabwe	ZW	Dollars	Earnings per hour	Employees	Men and Women	5B	Total	20.48	29.38	45.94	80.15	144	

INTERNATIONAL LABOUR ORGANIZATION Geneva
LABORSTA Labour Statistics Database

CAPITAL TRADE EXTRACTION OF DATA FROM ILO WEBSITE

Selection: years: 1994-2003
country(ies): AD AE AF AG AI AL AM AN AO AR AS AT AU AW AZ BA BB BD BE BF BG BH BI BJ BM BN BO BR BS BT BW BY BZ CA CD CF CG CH CI CK CL CM CN CO CR CS CU CV CY CZ D1 D2 D3 DE DJ DK DM DO DZ EC EE EG EH ER ES ET FI FJ FK FO FR GA GB GD GE GF GH GI GL GM GN GP GQ GR GT GU GW GY HK HN HR HT HU ID IE IL IM IN IQ IR IS IT JE JG JM JO JP KE KG KH KI KM KN KP KR KS KW KY KZ LA LB LC LI LK LR LS LT LU LV LY M1 M2 M3 MA MC MD MG MH MK ML MM MN MO MP MQ MR MS MT MU MV MW MX MY MZ NA NC NE NF NG NI NL NO NP NR NU NZ OM PA PE PF PG PH PK PL PM PR PS PT PW PY QA RE RO RU RW SA SB SC SD SE SG SH SI SK SL SM SN SO SR ST SU SV SY SZ T1 T2 TC TD TG TH TJ TK TL TM TN TO TR TT TV TW TZ UA UG US UY UZ VC VE VG VI VN VU WF WS Y1 Y2 Y3 YE YU ZA ZM ZW
table: 5B
extracted on 30/06/2005.

NOTE: No limit to extraction based ----> on specified country codes--wages available for many more countries.

For notes, please refer to the HTML table

COUNTRY	CODE COUNTRY	CURRENCY	TYPE OF DATA	WORKER COVERAGE	SEX	CODE TABLE	SUB-CLASSIFICATION	D1997	D1998	D1999	D2000	D2001	D2002	D2003
Albania	AL	Leks	Earnings per month	Employees	Men and Women	5B	Total	9121	9674	10734	11708	14056	14334	
Algeria	DZ	Dinars	Earnings per month	Employees	Men and Women	5B	Total							
Anguilla	AI	Dollars, EC	Earnings per month	Employees	Men and Women	5B	Total				1494.73			
Argentina	AR	Pesos	Earnings per hour	Wage earners	Men and Women	5B	Total	4.07	4.12	4.16	4.23	4.29		
Armenia	AM	Dram	Earnings per month	Employees	Men and Women	5B	Total	17656	21278	24515	29307	35848	40362	53048
Australia	AU	Dollars	Earnings per hour	Employees	Men and Women	5B	Total		17.38		18.16		20.45	
Austria	AT	Euros	Earnings per month	Wage earners	Men and Women	5B	Total				1973	2046		
Azerbaijan	AZ	Manats	Earnings per month	Employees	Men and Women	5B	Total	200030	202083	244087	284272	303164	348816	445437
Bahrain	BH	Dinars	Earnings per month	Employees	Men and Women	5B	Total		257	227	231	215	228	
Bangladesh	BD	Taka	Wage rates per day	Skilled	Men and Women	5B	Total							
Belarus	BY	Roubles	Earnings per month	Employees	Men and Women	5B	Total							
Belgium	BE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total			11				
Bolivia	BO	Bolivianos	Wage rates per month	Employees	Men and Women	5B	Total	873	972	1055	1120			
Botswana	BW	Pula	Earnings per month	Employees	Men and Women	5B	Total	598	695	785	783	891	889	944
Brazil	BR	Reais	Earnings per month	Employees	Men and Women	5B	Total	737.69	717.36	752.21	763.11	844.61	901.85	
Bulgaria	BG	Leva	Earnings per month	Employees	Men and Women	5B	Total	148460	194612	203	219	227	244	
Cambodia	KH	Riels	Wage rates per month	Employees	Men and Women	5B	Total		243000			243000		
Canada	CA	Dollars	Earnings per hour	Wage earners	Men and Women	5B	Total	17.23	17.59	17.82	18.29	18.59	19.1	19.7
Chile	CL	Pesos	Earnings per month	Employees	Men and Women	5B	Total	189753	200773	203540	208257	213394	218740	221860
China	CN	Yuan	Earnings per month	Employees	Men and Women	5B	Total	494.42	588.67	649.5	729.17	814.5	916.75	
Colombia	CO	Pesos	Earnings per month	Employees	Men and Women	5B	Total						353590	442510
Costa Rica	CR	Colones	Earnings per month	Employees	Men and Women	5B	Total		85899	97774.5	108777	128207		
Croatia	HR	Kunas	Earnings per month	Employees	Men and Women	5B	Total	3358	3681	3869	4100	4465	4794	5043
Cuba	CU	Pesos	Earnings per month	Employees	Men and Women	5B	Total	212	214	225	234	245	263	
Cyprus	CY	Pounds	Earnings per hour	Wage earners	Men and Women	5B	Total					3.72	3.94	
Czech Republic	CZ	Koruny	Earnings per hour	Wage earners	Men and Women	5B	Total	60.26	66.51					
Denmark	DK	Kroner	Earnings per hour	Employees	Men and Women	5B	Total	167.31	174.59	182.34	188.59	199.1	207.02	
Dominican Republic	DO	Pesos	Earnings per hour	Total employment	Men and Women	5B	Total	21.6						
Ecuador	EC	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total	4380.4	6119	8556.2	0.81	1.27		
Egypt	EG	Pounds	Earnings per week	Wage earners	Men and Women	5B	Total	103	107	121	125	136	147	
El Salvador	SV	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total		10.27	10.68	10.09		1.21	1.25
Eritrea	ER	Nakfa	Wage rates per month	Employees	Men and Women	5B	Total							
Estonia	EE	Kroons	Earnings per month	Employees	Men and Women	5B	Total	3733	4243	4374	4844	5337	5884	
Fiji	FJ	Dollars	Wage rates per day	Wage earners	Men and Women	5B	Total	15.12	14.48	15.15				
Finland	FI	Euros	Earnings per month	Employees	Men and Women	5B	Total	11677	12054	12510	13124	2275	2357	
France	FR	Euros	Earnings per month	Employees	Men and Women	5B	Total			1459	1477	1507	1563	
Gambia	GM	Dalasis	Earnings per month	Employees	Men and Women	5B	Total		969.69					
Georgia	GE	Lari	Earnings per month	Employees	Men and Women	5B	Total	51.2	68.9	87.4	99.3	120.8	143.4	152.5
Germany	DE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total	26.17	26.78	27.53	27.78	14.42	14.72	15.09
Gibraltar	GI	Pounds	Earnings per hour	Wage earners	Men and Women	5B	Total		6.58	6.83	6.44	6.56	7.02	7.21
Greece	GR	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total	1470.5	1539.76					
Guam	GU	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total							
Guatemala	GT	Quetzales	Earnings per month	Employees	Men and Women	5B	Total	1430.13	1541.03	1602.25	1655.25	1732.27	1837.32	
Guinea	GN	Francs	Wage rates per month	Employees	Men and Women	5B	Total							
Hong Kong, China	HK	Dollars	Wage rates per day	Wage earners	Men and Women	5B	Total	322.6	335.3	334.7	335.4	342.6	326.1	
Hungary	HU	Forint	Earnings per month	Employees	Men and Women	5B	Total	58915	68872	76099	88551	101700	114297	124076
Iceland	IS	Kronur	Earnings per hour	Employees	Men and Women	5B	Total		828	864	945	1049	1108	1173
India	IN	Rupees	Earnings per month	Wage earners	Men and Women	5B	Total	1137.3	1211.1	1548.5	1280.8	1893.2		
Indonesia	ID	Rupiahs	Wage rates per week	Wage earners	Men and Women	5B	Total	52.4	64.2	75.3	98	129.2		
Iran, Islamic Rep. of	IR	Rials	Earnings per month	Employees	Men and Women	5B	Total	471489	567630	698899	867526	1014285		
Ireland	IE	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total			9.79	10.4	11.47	12.29	12.96
Isle of Man	IM	Pounds	Earnings per hour	Employees	Men and Women	5B	Total	7.1	7.84	9.08	8.53	9.02	10.26	9.65
Israel	IL	New Shekels	Earnings per month	Employees	Men and Women	5B	Total					9088	9179	9218
Italy	IT	Euros	Earnings per month	Employees	Men and Women	5B	Total							
Japan	JP	Yen	Earnings per month	Employees	Men and Women	5B	Total	287200	289600	291100	293100	297500	296400	296500

INTERNATIONAL LABOUR ORGANIZATION Geneva *(Continued)* **CAPITAL TRADE EXTRACTION OF DATA FROM ILO WEBSITE**

LABORSTA Labour Statistics Database

Selection: years: 1994-2003

table: 5B

extracted on 30/06/2005.

For notes, please refer to the HTML table

COUNTRY	CODE COUNTRY	CURRENCY	TYPE OF DATA	WORKER COVERAGE	SEX	CODE TABLE	SUB-CLASSIFICATION	D1997	D1998	D1999	D2000	D2001	D2002	D2003
Jordan	JO	Dinars	Earnings per month	Employees	Men and Women	5B	Total	192.9	198.5	172	189	185		
Kazakhstan	KZ	Tenges	Earnings per month	Employees	Men and Women	5B	Total	11092	11357	13821	17717	19982	22130	24823
Kenya	KE	Shillings	Earnings per month	Employees	Men and Women	5B	Total	5510.8						
Korea, Republic of	KR	Won	Earnings per month	Employees	Men and Women	5B	Total			1443	1568	1659	1857	
Kuwait	KW	Dinars	Earnings per hour	Employees	Men and Women	5B	Total	1.219	1.246	1.231	1.355			
Kyrgyzstan	KG	Soms	Earnings per month	Employees	Men and Women	5B	Total	844.7	1405.8	1962.3	2020.1	2390.6	2833.5	3182.6
Latvia	LV	Lats	Earnings per month	Employees	Men and Women	5B	Total	114.7	128.31	128.97	135.13	140.34	145.51	159.26
Lithuania	LT	Litas	Earnings per hour	Employees	Men and Women	5B	Total	4.89	5.86	6.16	6.21	6.33	6.48	6.6
Luxembourg	LU	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total	465	470	12.22	12.54	12.62	13.1	13.49
Macau, China	MO	Patacas	Earnings per month	Total employment	Men and Women	5B	Total		3080	2921	2960	2760	2766	2840
Macedonia, The former Yugoslav Rep. of	MK	Denars	Earnings per month	Employees	Men and Women	5B	Total						9944	10028
Malawi	MW	Kwacha	Earnings per month	Employees	Men and Women	5B	Total							
Malaysia	MY	Ringgit	Earnings per month	Employees	Men and Women	5B	Total	1210			1388	1531		
Malta	MT	Pounds	Earnings per hour	Total employment	Men and Women	5B	Total				2.1	2.2	2.3	2.3
Mauritius	MU	Rupees	Earnings per month	Employees	Men and Women	5B	Total			5142	5544	5856	6155	6668
Mexico	MX	Nuevos Pesos	Earnings per hour	Wage earners	Men and Women	5B	Total	12.38	14.84	17.82	20.77	23.53	25.19	26.85
Moldova, Rep. of	MD	Leu	Earnings per month	Employees	Men and Women	5B	Total	352	399	492.6	677.7	813.1	971.8	1216.1
Mongolia	MN	Tughriks	Earnings per month	Employees	Men and Women	5B	Total				66		68.7	82.7
Netherlands	NL	Euros	Earnings per hour	Employees	Men and Women	5B	Total	31.05	32.02	33.32	34.42			
New Zealand	NZ	Dollars	Earnings per hour	Employees	Men and Women	5B	Total				16.99	17.39	18	18.82
Nicaragua	NI	Córdobas	Earnings per hour	Employees	Men and Women	5B	Total	11.19	12	12	13.24	13.45	13.46	
Norway	NO	Kroner	Earnings per month	Employees	Men and Women	5B	Total	20005	21417	22441	23388	24426	25991	26944
Pakistan	PK	Rupees	Earnings per month	Employees	Men and Women	5B	Total	3211.54	3705.96	2865.76	2980.97	3002.23	4113.74	
Panama	PA	Balboas	Earnings per hour	Total employment	Men and Women	5B	Total						1.8	1.7
Paraguay	PY	Guaranies	Earnings per month	Employees	Men and Women	5B	Total				813765	639988	739738	816428
Peru	PE	Nuevos Soles	Wage rates per day	Wage earners	Men and Women	5B	Total	24.45	24.93	25.56	27.23	27.12	28.07	27.17
Philippines	PH	Pesos	Earnings per month	Employees	Men and Women	5B	Total		6400	6900	7300			
Poland	PL	New Zlotys	Earnings per month	Employees	Men and Women	5B	Total	1014.9	1164.4	1598.89	1756.43	1866.51	1911.52	2034.03
Portugal	PT	Euros	Earnings per hour	Wage earners	Men and Women	5B	Total		703	718				
Puerto Rico	PR	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total	7.99	8.41	8.93	9.39	9.84	10.3	10.47
Qatar	QA	Riyals	Earnings per month	Total employment	Men and Women	5B	Total					1546		
Romania	RO	Lei	Earnings per month	Employees	Men and Women	5B	Total	826902	1198560	1712748	2535223	3734701	4632583	
Russian Federation	RU	Roubles	Earnings per month	Employees	Men and Women	5B	Total		1026					
Rwanda	RW	Francs	Earnings per month	Employees	Men and Women	5B	Total	27659						
Saint Helena	SH	Pounds	Earnings per month	Employees	Men and Women	5B	Total	236.3	246.8	237.5	263.1	263.4	296.8	
Saint Vincent and the Grenadines	VC	Dollars, EC	Wage rates per day	Employees	Men and Women	5B	Total	25	25	25.75	25.75	26.52	26.52	
San Marino	SM	Euros	Earnings per month	Employees	Men and Women	5B	Total					3289004	1868	1922
Saudi Arabia	SA	Riyals	Earnings per week	Employees	Men and Women	5B	Total	657						
Serbia and Montenegro	YU	New Dinars	Earnings per month	Employees	Men and Women	5B	Total	647	823	1053	2230	4786	7866	8991
Seychelles	SC	Rupees	Earnings per month	Employees	Men and Women	5B	Total	2727	2853	2962	3067	3235	3300	
Singapore	SG	Dollars	Earnings per month	Employees	Men and Women	5B	Total		2716	2803	3036	3117	3154	3265
Slovakia	SK	Koruny	Earnings per month	Employees	Men and Women	5B	Total	9197	9980	10758	11722	12908	13837	14873
Slovenia	SI	Tolars	Earnings per month	Employees	Men and Women	5B	Total	118960	132080	144110	161296	178596	196220	211060
Solomon Islands	SB	Dollars	Earnings per month	Employees	Men and Women	5B	Total							
South Africa	ZA	Rand	Earnings per month	Employees	Men and Women	5B	Total	3408	3803	4018	4323	4701	5197	
Spain	ES	Euros	Earnings per hour	Employees	Men and Women	5B	Total			9.75	10.04	10.46	10.97	11.5
Sri Lanka	LK	Rupees	Earnings per hour	Wage earners	Men and Women	5B	Total	18.15	20.34	22.03	24.86	27.1	31.93	33.21
Sweden	SE	Kronor	Earnings per hour	Wage earners	Men and Women	5B	Total	101.24	105.07	106.85	111.3	114.9	118.2	122
Switzerland	CH	Francs	Earnings per month	Employees	Men and Women	5B	Total		5717		5862		6155	
Taiwan, China	TW	Taiwan Dollar	Earnings per month	Employees	Men and Women	5B	Total	35456	36436	37686	38792	38277	38208	
Tajikistan	TJ	Roubles	Earnings per month	Employees	Men and Women	5B	Total	14977						
Thailand	TH	Baht	Wage rates per month	Employees	Men and Women	5B	Total					6064.6		
Tonga	TO	Pa'anga	Earnings per week	Employees	Men and Women	5B	Total							
Trinidad and Tobago	TT	Dollars	Earnings per week	Employees	Men and Women	5B	Total	865.44	908.73	938.82	1170.12	1161.15	1161.63	
Turkey	TR	Liras	Earnings per hour	Employees	Men and Women	5B	Total	428.7	781.6	1397	2163.3	2917.6		
Ukraine	UA	Hrivna	Earnings per month	Employees	Men and Women	5B	Total				270.7	368.3	441.3	552.9
United Kingdom	GB	Pounds	Earnings per hour	Employees	Men and Women	5B	Total	8.61	9.17	9.55	9.96	10.53	11.02	11.43
United States	US	Dollars	Earnings per hour	Wage earners	Men and Women	5B	Total	13.17	13.49	13.9	14.37	14.83	15.3	
Uruguay	UY	Pesos	Earnings per month	Employees	Men and Women	5B	Total				6855	6856		
Venezuela	VE	Bolivares	Earnings per month	Employees	Men and Women	5B	Total	141122						
Virgin Islands (British)	VG	Dollars	Earnings per hour	Employees	Men and Women	5B	Total							
Virgin Islands (US)	VI	Dollars, US	Earnings per hour	Wage earners	Men and Women	5B	Total	18.09						
West bank and Gaza strip	PS	New Shekels	Earnings per day	Employees	Men and Women	5B	Total	49.9	57.3	65.4	68.8	68	70.1	
Zimbabwe	ZW	Dollars	Earnings per hour	Employees	Men and Women	5B	Total	16.37	20.48	29.38	45.94	80.15	144	

Note: Where data were not available, the ILO extraction did not generate data, which is why there are country codes in the extraction instructions where no data are reported. When making the data request, Capital Trade requested data for each continent to insure complete coverage. See attached, which is the instruction page on the ILO website from which these data were downloaded.

YEARLY DATA

Select one or more countries/groups of countries:

AFRICA
AMERICAS
ASIA
EUROPE
OCEANIA
Afghanistan

Select the first year: 1995 **and the last year:** 2004

Select one or more tables:

1A Total and economically active population, by age group
1B Economically active population, by level of education and age group
2A Employment, general level
2B Total employment, by economic activity
2C Total employment, by occupation
2D Total employment, by status in employment

>>

Attachment 3

History of Countries Relied on by Department of Commerce for NME Wage Rate Regresssions

1995	1997	1998	1999	2000	2001	2002	2003
		Algeria	Algeria	Algeria	Algeria	Algeria	**1996 latest ILO**
Argentina	Argentina	Argentina	Argentina	Argentina	Argentina	Argentina	Argentina
Australia	Australia	Australia	Australia	Australia	Australia	Australia	Australia
Austria	Austria	Austria	Austria	Austria	Austria	Austria	Austria
	Bahrain					**All Data Available**	**2003 CPI unavailable**
Belgium		Belgium	Belgium	Belgium	Belgium	Belgium	Belgium
Bolivia		Bolivia	Bolivia	Bolivia	Bolivia	Bolivia	Bolivia
	Bangladesh					**1996 latest ILO**	**1996 latest ILO**
Botswana	Botswana	Botswana	Botswana	Botswana	Botswana	Botswana	Botswana
		Brazil	Brazil	Brazil	Brazil	Brazil	Brazil
			Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria
Canada	Canada	Canada	Canada	Canada	Canada	Canada	Canada
Chile	Chile	Chile	Chile	Chile	Chile	Chile	Chile
	Colombia	Colombia	Colombia	Colombia	Colombia	Colombia	Colombia
Costa Rica	Costa Rica	Costa Rica	Costa Rica	Costa Rica	Costa Rica	Costa Rica	Costa Rica
	Croatia	Croatia	Croatia	Croatia	Croatia	Croatia	Croatia
Denmark	Denmark					**All Data Available**	**All Data Available**
Dominican Republic	Dominican Republic	Dominican Republic	Dominican Republic	Dominican Republic	Dominican Republic	Dominican Republic	**1997 latest ILO**
Ecuador	Ecuador		Ecuador	Ecuador	Ecuador	Ecuador	Ecuador
Egypt	Egypt	Egypt	Egypt	Egypt	Egypt	Egypt	Egypt
El Salvador	El Salvador	El Salvador	El Salvador	El Salvador	El Salvador	El Salvador	El Salvador
	Fiji					**All Data Available**	**All Data Available**
Finland	Finland	Finland	Finland	Finland	Finland	Finland	Finland
France	France	France	France	France	France	France	France
Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany
Greece	Greece	Greece	Greece	Greece	Greece	Greece	Greece
Guatemala	Guatemala	Guatemala	Guatemala	Guatemala	Guatemala	Guatemala	Guatemala
India	India	India	India	India	India	India	India
Ireland	Ireland	Ireland	Ireland	Ireland	Ireland	Ireland	Ireland
Israel	Israel	Israel	Israel	Israel	Israel	Israel	Israel
	Jamaica					**No ILO Data**	**No ILO Data**
Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan
Jordan	Jordan	Jordan	Jordan	Jordan	Jordan	Jordan	Jordan
Kenya	Kenya	Kenya	Kenya	Kenya	Kenya	Kenya	**1997 latest ILO**
Korea	Korea	Korea	Korea	Korea	Korea	Korea	Korea
	Luxemborg					**All Data Available**	**All Data Available**
	Malaysia	Malaysia	Malaysia	Malaysia	Malaysia	Malaysia	Malaysia
	Malta					**All Data Available**	**All Data Available**
Mauritius	Mauritius		Mauritius	Mauritius	Mauritius	Mauritius	Mauritius
Mexico	Mexico	Mexico	Mexico	Mexico	Mexico	Mexico	Mexico
Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands
New Zealand	New Zealand	New Zealand	New Zealand	New Zealand	New Zealand	New Zealand	New Zealand
			Nicaragua	Nicaragua	Nicaragua	Nicaragua	Nicaragua
Norway	Norway	Norway	Norway	Norway	Norway	Norway	Norway
Pakistan	Pakistan	Pakistan	Pakistan	Pakistan	Pakistan	Pakistan	Pakistan
	Panama	Panama	Panama	Panama	Panama	Panama	Panama
Paraguay	Paraguay		Paraguay	Paraguay	Paraguay	Paraguay	Paraguay
Peru		Peru	Peru	Peru	Peru	Peru	Peru
Philippines	Philippines	Philipines	Philippines	Philippines	Philippines	Philippines	Philippines
Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland
Portugal	Portugal	Portugal				**All Data Available**	**All Data Available**
	Seychelles					**All Data Available**	**All Data Available**
Singapore	Singapore	Singapore	Singapore	Singapore	Singapore	Singapore	Singapore
	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia
South Africa	South Africa		South Africa	South Africa	South Africa	South Africa	South Africa
Spain	Spain	Spain	Spain	Spain	Spain	Spain	Spain
Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka
Sweden	Sweden	Sweden	Sweden	Sweden	Sweden	Sweden	Sweden
Switzerland	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland
Thailand	Thailand	Thailand	Thailand	Thailand	Thailand	Thailand	Thailand
	Tonga					**1994 latest ILO**	**1994 latest ILO**
	Trinidad/Tobago		Trinidad/Tobago	Trinidad/Tobago	Trinidad/Tobago	Trinidad/Tobago	Trinidad/Tobago
	Turkey		Turkey	Turkey	Turkey	Turkey	Turkey
United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom
	United States	United States	United States	United States	United States	United States	United States
		Zimbabwe	Zimbabwe	Zimbabwe	Zimbabwe	**2002 GNI not available**	**2003 GNI is estimate**

e Administration (Import Adminstration) website, at: http://ia.ita.doc.gov/wages/index.html

Attachment 4

Wage Rate and Per Capita GNI Data for Excluded Countries -- 2003 Base Year

From Extraction of Data from ILO Website on June 30, 2005 (See Attachment 2)										Calculations					
Country	Reported Wage Rate	Data Year	Measuring Currency	Measuring Unit	Hours per Measuring Unit	Worker coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/ hour	Inflator	Home Currency/ hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr.	Per Capita GNI
Albania	14,334.0	2003	Leks	month	192	Employees	Men and Women	Total	5B	74.66	1.00	75.02	0.0082	0.617	1,740
Bahrain*	228.0	2002	Dinars	month	192	Employees	Men and Women	Total	5B	1.19	n/a	n/a	2.6596	n/a	10,850
Cambodia	243,000.0	2001	Riels	month	192	Employees	Men and Women	Total	5B	1265.63	1.04	1322.26	0.0003	0.333	300
Czech Republic	15,832.0	2003	Koruny	month	192	Employees	Men and Women	Total	5B	82.46	1.00	82.46	0.0355	2.928	7,150
Denmark	207.0	2002	Kroner	hour	1	Employees	Men and Women	Total	5B	207.02	1.02	211.08	0.1521	32.102	33,570
Fiji	15.2	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	1.89	1.11	2.10	0.5286	1.108	2,240
Gambia*	969.7	1998	Dalasis	month	192	Employees	Men and Women	Total	5B	5.05	n/a	n/a	0.0368	n/a	270
Hong Kong, China	326.1	2002	Dollars	day	8	Wage earners	Men and Women	Total	5B	40.76	0.97	39.71	0.1284	5.099	25,860
Hungary	124,076.0	2003	Forint	month	192	Employees	Men and Women	Total	5B	646.23	1.00	646.23	0.0045	2.883	6,350
Iceland	1,173.0	2003	Kronur	hour	1	Employees	Men and Women	Total	5B	1173.00	1.00	1173.00	0.0130	15.305	30,910
Indonesia	129.2	2001	Rupiahs (1,000)	week	44	Wage earners	Men and Women	Total	5B	2936.36	1.19	3501.52	0.0001	0.408	810
Iran, Islamic Rep. of	1,014,285	2001	Rials	month	192	Employees	Men and Women	Total	5B	5282.73	1.33	7034.75	0.0001	0.859	2,010
Kazakhstan	24,823.0	2003	Tenges	month	192	Employees	Men and Women	Total	5B	129.29	1.00	129.29	0.0067	0.865	1,780
Kuwait	1.4	2000	Dinars	hour	1	Employees	Men and Women	Total	5B	1.36	1.04	1.41	3.3557	4.733	17,960
Latvia	159.3	2003	Lats	month	192	Employees	Men and Women	Total	5B	0.83	1.00	0.83	1.7507	1.452	4,400
Lithuania	6.6	2003	Litas	hour	1	Employees	Men and Women	Total	5B	6.60	1.00	6.60	0.3273	2.160	4,500
Luxembourg	13.5	2003	Euros	hour	1	Wage earners	Men and Women	Total	5B	13.49	1.00	13.49	1.1308	15.255	45,740
Macedonia	10,028.0	2003	Denars	month	192	Employees	Men and Women	Total	5B	52.23	1.00	52.23	0.0184	0.963	1,980
Malta	2.3	2003	Pounds	hour	1	Total employment	Men and Women	Total	5B	2.30	1.00	2.30	2.6544	6.105	10,780
Mongolia	82.7	2003	Tughriks (1,000)	month	192	Employees	Men and Women	Total	5B	430.73	1.00	430.73	0.0009	0.376	480
Portugal**	718.0	1999	PTE	hour	1	Wage earners	Men and Women	Total	5B	718.00	1.15	825.06	0.0056	4.642	11,800
Serbia and Montenegro***	8,991.0	2003	New Dinars	month	192	Employees	Men and Women	Total	5B	46.83	1.00	46.83	0.0173	0.812	1,910
Seychelles	3,300.0	2002	Rupees	month	192	Employees	Men and Women	Total	5B	17.19	1.03	17.76	0.1854	3.292	7,490
Slovakia	14,873.0	2003	Koruny	month	192	Employees	Men and Women	Total	5B	77.46	1.00	77.46	0.0273	2.111	4,940
Uruguay	6,856.0	2001	Pesos	month	192	Employees	Men and Women	Total	5B	35.71	1.36	48.58	0.0355	1.724	3,820
West Bank & Gaza*	70.1	2002	New Shekels	day	8	Employees	Men and Women	Total	5B	8.76	n/a	n/a	0.2199	n/a	1,110

* Excluded from analysis because no CPI data available for 2003 from IFS of IMF

** According to ILO, 1 Euro = 200.482 PTE for wages reported prior to 2000.

*** Exchange rate data from www.oanda.com, since not included on Commerce exchange rate file.

Inflation Calculations for Excluded Countries Where 2003 ILO Wage Data Not Available

Country	Wage Year	1998	1999	2000	2001	2002	2003
Bahrain	2002	102.2	100.7	100.0	100.2	101.5	n/a
Cambodia	2001		100.8	100.0	99.4	102.6	103.8
Denmark	2002		97.3	100.0	102.3	104.7	106.8
Fiji	1999	97.0	98.9	100.0	104.3	105.1	109.5
Gambia	1998	97.7	99.8	100.0	108.1	113.4	n/a
Hong Kong, China	2002		103.9	100.0	98.4	95.4	92.9
Indonesia	2001	80.0	96.4	100.0	111.5	124.7	133.0
Iran, Islamic Rep. of	2001		87.4	100.0	111.3	127.2	148.2
Kuwait	2000		98.2	100.0	101.7	103.1	104.1
Portugal	1999		97.3	100.0	104.4	108.3	111.8
Seychelles	2002		94.1	100.0	106.0	106.2	109.7
Uruguay	2001		95.5	100.0	104.4	118.9	142.0
West Bank & Gaza	2002	None available					

Source: International Financial Statistics of the International Monetary Fund.

Attachment 5

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2003

Country	$/hr	Per Capita	World Bank Classification
Albania	0.62	1,740	LMI
Argentina	2.12	3,810	UMI
Australia	13.70	21,950	HI
Austria	12.44	26,810	HI
Belgium	13.50	25,760	HI
Bolivia	0.81	900	LMI
Botswana	1.00	3,530	UMI
Brazil	1.76	2,720	LMI
Bulgaria	0.75	2,130	LMI
Cambodia	0.33	300	LI
Canada	14.10	24,470	HI
Chile	1.70	4,360	UMI
Colombia	0.80	1,810	LMI
Costa Rica	2.00	4,300	UMI
Croatia	3.92	5,370	UMI
Czech Republic	2.93	7,150	UMI
Denmark	32.10	33,570	HI
Ecuador	1.54	1,830	LMI
Egypt	0.60	1,390	LMI
El Salvador	1.25	2,340	LMI
Fiji	1.11	2,240	LMI
Finland	14.00	27,060	HI
France	9.40	24,730	HI
Germany	17.06	25,270	HI
Greece	5.92	13,230	HI
Guatemala	1.27	1,910	LMI
Hong Kong	5.10	25,860	HI
Hungary	2.88	6,350	UMI
Iceland	15.31	30,910	HI
India	0.23	540	LI
Indonesia	0.41	810	LMI
Iran	0.86	2,010	LMI
Ireland	14.66	27,010	HI
Israel	10.56	16,240	HI
Japan	13.34	34,180	HI
Jordan	1.41	1,850	LMI
Kazakhstan	0.87	1,780	LMI
Korea, Republic	9.07	12,030	HI
Kuwait	4.73	17,960	HI
Latvia	1.45	4,400	UMI
Lithuania	2.16	4,500	UMI
Luxembourg	15.26	45,740	HI
Macedonia	0.96	1,980	LMI
Malaysia	2.16	3,880	UMI
Malta	6.11	10,780	HI
Mauritius	1.25	4,100	UMI
Mexico	2.49	6,230	UMI
Mongolia	0.38	480	LI
Netherlands	19.71	26,230	HI
New Zealand	10.96	15,530	HI
Nicaragua	0.94	740	LI
Norway	19.73	43,400	HI
Pakistan	0.38	520	LI
Panama	1.70	4,060	UMI
Paraguay	0.66	1,110	LMI
Peru	0.98	2,140	LMI
Philippines	0.80	1,080	LMI
Poland	2.73	5,280	UMI
Portugal	4.64	11,800	HI
Serbia and Montenegro	0.81	1,910	LMI
Seychelles	3.29	7,490	UMI
Singapore	9.76	21,230	HI
Slovakia	2.11	4,940	UMI
Slovenia	5.31	11,920	HI
South Africa	3.82	2,750	UMI
Spain	13.00	17,040	HI
Sri Lanka	0.34	930	LMI
Sweden	15.12	28,910	HI
Switzerland	23.98	40,680	HI
Thailand	0.78	2,190	LMI
Trinidad and Tobago	4.35	7,790	UMI
Turkey	3.56	2,800	UMI
United Kingdom	18.68	28,320	HI
United States	15.65	37,870	HI
Uruguay	1.72	3,820	UMI
Average	6.05	11,504	
DOC Included Countries	6.69	12,197	
DOC Excluded Countries	4.61	9,936	

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (52)	LI and LMI (17)	1,537
	UMI and HI (35)	17,375
	All (52)	12,197
Excluded Countries (23)	LI and LMI (9)	1,472
	UMI and HI (14)	15,376
	All (23)	9,936
All Countries (75)	LI and LMI (26)	1,515
	UMI and HI (49)	16,804
	All (75)	11,504

Sources:

Countries in Bold, supporting wage rate calculations in Attachment 4.
Other countries, data files contained on Commerce website supporting 2003 sample calculations.

Cyprus, Macao (No firm 2003 GNI data from World Bank)
Bahrain, Gambia, West Bank/Gaza (No CPI data for 2003 from IFS)
Estonia, Russia, Romania (ILO wage prior to market economy status)

Country Groups

By Region
- East Asia and Pacific
- Europe and Central Asia
- Latin America & the Caribbean
- Middle East and North Africa
- South Asia
- Sub-Saharan Africa

By Income
- Low-income economies
- Lower-middle-income economies
- Upper-middle-income economies
- High-income economies
- High-income OECD members

By Indebtedness
- Severely indebted
- Moderately indebted
- Less indebted
- Not classified

East Asia and Pacific (developing only: 24)

American Samoa	Malaysia	Philippines
Cambodia	Marshall Islands	Samoa
China	Micronesia, Fed. Sts	Solomon Islands
Fiji	Mongolia	Thailand
Indonesia	Myanmar	Timor-Leste
Kiribati	Northern Mariana Islands	Tonga
Korea, Dem. Rep.	Palau	Vanuatu
Lao PDR	Papua New Guinea	Vietnam

Europe and Central Asia (developing only: 27)

Albania	Hungary	Serbia and Montenegro
Armenia	Kazakhstan	Slovak Republic
Azerbaijan	Kyrgyz Republic	Tajikistan
Belarus	Latvia	Turkey
Bosnia and Herzegovina	Lithuania	Turkmenistan
Bulgaria	Macedonia, FYR	Ukraine
Croatia	Moldova	Uzbekistan
Czech Republic	Poland	
Estonia	Romania	
Georgia	Russian Federation	

Latin America and the Caribbean (developing only: 32)

Antigua and Barbuda	Dominican Republic	Panama
Argentina	Ecuador	Paraguay
Barbados	El Salvador	Peru
Belize	Grenada	St. Kitts and Nevis
Bolivia	Guatemala	St. Lucia
Brazil	Guyana	St. Vincent and the Grenadines
Chile	Haiti	Suriname
Colombia	Honduras	Trinidad and Tobago
Costa Rica	Jamaica	Uruguay
Cuba	Mexico	Venezuela, RB
Dominica	Nicaragua	

Middle East and North Africa (developing only: 14)

Algeria	Jordan	Syrian Arab Republic
Djibouti	Lebanon	Tunisia
Egypt, Arab Rep.	Libya	West Bank and Gaza
Iran, Islamic Rep.	Morocco	Yemen, Rep.
Iraq	Oman	

South Asia (8)

Afghanistan	India	Pakistan
Bangladesh	Maldives	Sri Lanka
Bhutan	Nepal	

Sub-Saharan Africa (48)

Angola	Gabon	Niger
Benin	Gambia, The	Nigeria
Botswana	Ghana	Rwanda
Burkina Faso	Guinea	Sao Tome and Principe
Burundi	Guinea-Bissau	Senegal
Cameroon	Kenya	Seychelles
Cape Verde	Lesotho	Sierra Leone
Central African Republic	Liberia	Somalia
Chad	Madagascar	South Africa
Comoros	Malawi	Sudan
Congo, Dem. Rep.	Mali	Swaziland
Congo, Rep	Mauritania	Tanzania
Cote d'Ivoire	Mauritius	Togo
Equatorial Guinea	Mayotte	Uganda
Eritrea	Mozambique	Zambia
Ethiopia	Namibia	Zimbabwe

Low-income economies (59)

Afghanistan
Bangladesh
Benin
Bhutan
Burkina Faso
Burundi
Cambodia
Cameroon
Central African Republic
Chad
Comoros
Congo, Dem. Rep
Congo, Rep.
Cote d'Ivoire
Eritrea
Ethiopia
Gambia, The
Ghana
Guinea
Guinea-Bissau
Haiti
India
Kenya
Korea, Dem Rep.
Kyrgyz Republic
Lao PDR
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritania
Moldova
Mongolia
Mozambique
Myanmar
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Papua New Guinea
Rwanda
Sao Tome and Principe
Senegal
Sierra Leone
Solomon Islands
Somalia
Sudan
Tajikistan
Tanzania
Timor-Leste
Togo
Uganda
Uzbekistan
Vietnam
Yemen, Rep.
Zambia
Zimbabwe

Lower-middle-income economies (54)

Albania
Algeria
Angola
Armenia
Azerbaijan
Belarus
Bolivia
Bosnia and Herzegovina
Brazil
Bulgaria
Cape Verde
China
Colombia
Cuba
Djibouti
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Fiji
Georgia
Guatemala
Guyana
Honduras
Indonesia
Iran, Islamic Rep.
Iraq
Jamaica
Jordan
Kazakhstan
Kiribati
Macedonia, FYR
Maldives
Marshall Islands
Micronesia, Fed. Sts.
Morocco
Namibia
Paraguay
Peru
Philippines
Romania
Samoa
Serbia and Montenegro
Sri Lanka
Suriname
Swaziland
Syrian Arab Republic
Thailand
Tonga
Tunisia
Turkmenistan
Ukraine
Vanuatu
West Bank and Gaza

Upper-middle-income economies (40)

American Samoa
Antigua and Barbuda
Argentina
Barbados
Belize
Botswana
Chile
Costa Rica
Croatia
Czech Republic
Dominica
Equatorial Guinea
Estonia
Gabon
Grenada
Hungary
Latvia
Lebanon
Libya
Lithuania
Malaysia
Mauritius
Mayotte
Mexico
Northern Mariana Islands
Oman
Palau
Panama
Poland
Russian Federation
Seychelles
Slovak Republic
South Africa
St. Kitts and Nevis
St. Lucia
St. Vincent and the Grenadines
Trinidad and Tobago
Turkey
Uruguay
Venezuela, RB

High-income economies (55)

Andorra
Aruba
Australia
Austria
Bahamas, The
Bahrain
Belgium
Bermuda
Brunei
Canada
Cayman Islands
Channel Islands
Cyprus
Denmark
Faeroe Islands
Finland
France
French Polynesia
Germany
Greece
Greenland
Guam
Hong Kong, China
Iceland
Ireland
Isle of Man
Israel
Italy
Japan
Korea, Rep.
Kuwait
Liechtenstein
Luxembourg
Macao, China
Malta
Monaco
Netherlands
Netherlands Antilles
New Caledonia
New Zealand
Norway
Portugal
Puerto Rico
Qatar
San Marino
Saudi Arabia
Singapore
Slovenia
Spain
Sweden
Switzerland
United Arab Emirates
United Kingdom
United States
Virgin Islands (U.S.)

High-income OECD members (24)

Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Korea, Rep.
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States

Severely indebted (52)

- Angola
- Argentina
- Belize
- Bhutan
- Brazil
- Bulgaria
- Burundi
- Central African Republic
- Chad
- Comoros
- Congo, Dem. Rep.
- Congo, Rep.
- Cote d'Ivoire
- Croatia
- Dominica
- Ecuador
- Eritrea
- Estonia
- Gabon
- Gambia, The
- Grenada
- Guinea
- Guinea-Bissau
- Guyana
- Indonesia
- Jordan
- Kazakhstan
- Kyrgyz Republic
- Lao PDR
- Latvia
- Lebanon
- Liberia
- Malawi
- Myanmar
- Panama
- Peru
- Rwanda
- Samoa
- Sao Tome and Principe
- Serbia and Montenegro
- Seychelles
- Sierra Leone
- Somalia
- St. Kitts and Nevis
- Sudan
- Syrian Arab Republic
- Tajikistan
- Togo
- Turkey
- Uruguay
- Zambia
- Zimbabwe

Moderately indebted (39)

- Benin
- Bolivia
- Burkina Faso
- Cambodia
- Cameroon
- Cape Verde
- Chile
- Colombia
- El Salvador
- Ethiopia
- Honduras
- Hungary
- Jamaica
- Kenya
- Lithuania
- Madagascar
- Malaysia
- Mauritania
- Mauritius
- Moldova
- Mongolia
- Niger
- Nigeria
- Pakistan
- Papua New Guinea
- Paraguay
- Philippines
- Poland
- Russian Federation
- Slovak Republic
- Solomon Islands
- Sri Lanka
- St. Lucia
- St. Vincent and the Grenadines
- Tunisia
- Turkmenistan
- Uganda
- Uzbekistan
- Venezuela, RB

Less indebted (45)

- Albania
- Algeria
- Armenia
- Azerbaijan
- Bangladesh
- Barbados
- Belarus
- Bosnia and Herzegovina
- Botswana
- China
- Costa Rica
- Czech Republic
- Djibouti
- Equatorial Guinea
- Fiji
- Georgia
- Ghana
- Guatemala
- Haiti
- India
- Iran, Islamic Rep.
- Lesotho
- Macedonia, FYR
- Maldives
- Mali
- Mexico
- Nepal
- Nicaragua
- Oman
- Romania
- Senegal
- South Africa
- Swaziland
- Tanzania
- Thailand
- Tonga
- Trinidad and Tobago
- Ukraine
- Vanuatu

Dominican Republic
Egypt, Arab Rep.
Morocco
Mozambique
Vietnam
Yemen, Rep.

Not classified by indebtedness (72)

Afghanistan
American Samoa
Andorra
Antigua and Barbuda
Aruba
Australia
Austria
Bahamas, The
Bahrain
Belgium
Bermuda
Brunei
Canada
Cayman Islands
Channel Islands
Cuba
Cyprus
Denmark
Faeroe Islands
Finland
France
French Polynesia
Germany
Greece
Greenland
Guam
Hong Kong, China
Iceland
Iraq
Ireland
Isle of Man
Israel
Italy
Japan
Kiribati
Korea, Dem. Rep.
Korea, Rep.
Kuwait
Libya
Liechtenstein
Luxembourg
Macao, China
Malta
Marshall Islands
Mayotte
Micronesia, Fed. Sts.
Monaco
Namibia
Netherlands
Netherlands Antilles
New Caledonia
New Zealand
Northern Mariana Islands
Norway
Palau
Portugal
Puerto Rico
Qatar
San Marino
Saudi Arabia
Singapore
Slovenia
Spain
Suriname
Sweden
Switzerland
Timor-Leste
United Arab Emirates
United Kingdom
United States
Virgin Islands (U.S.)
West Bank and Gaza

Click here to download the country classification table in Excel format.

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Attachment 6

ILO Wage Rates for 23 Countries Excluded By Commerce from its 2003 Sample Wage Rate Calculations, 1998 - 2003

COUNTRY	CURRENCY	D1998	D1999	D2000	D2001	D2002	D2003
Albania	Leks	9674	10734	11708	14056	14334	
Cambodia	Riels	243000			243000		
Czech Republic	Koruny	66.51					
Denmark	Kroner	174.59	182.34	188.59	199.1	207.02	
Fiji	Dollars	14.48	15.15				
Hong Kong, China	Dollars	335.3	334.7	335.4	342.6	326.1	
Hungary	Forint	68872	76099	88551	101700	114297	124076
Iceland	Kronur	828	864	945	1049	1108	1173
Indonesia	Rupiahs	64.2	75.3	98	129.2		
Iran, Islamic Rep. of	Rials	567630	698899	867526	1014285		
Kazakhstan	Tenges	11357	13821	17717	19982	22130	24823
Kuwait	Dinars	1.246	1.231	1.355			
Latvia	Lats	128.31	128.97	135.13	140.34	145.51	159.26
Litnuania	Litas	5.86	6.16	6.21	6.33	6.48	6.6
Luxembourg	Euros	470	12.22	12.54	12.62	13.1	13.49
Macedonia	Denars					9944	10028
Malta	Pounds			2.1	2.2	2.3	2.3
Mongolia	Tughriks			66		68.7	82.7
Portugal	Euros	703	718				
Serbia and Montenegro	New Dinars	823	1053	2230	4786	7866	8991
Seychelles	Rupees	2853	2962	3067	3235	3300	
Slovakia	Koruny	9980	10758	11722	12908	13837	14873
Uruguay	Pesos			6855	6856		

Source: International Labor Organization. See Attachment 2.

Attachment 7

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2003

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.914
R Square	0.836
Adjusted R Square	0.833
Standard Error	2.819
Observations	75

ANOVA

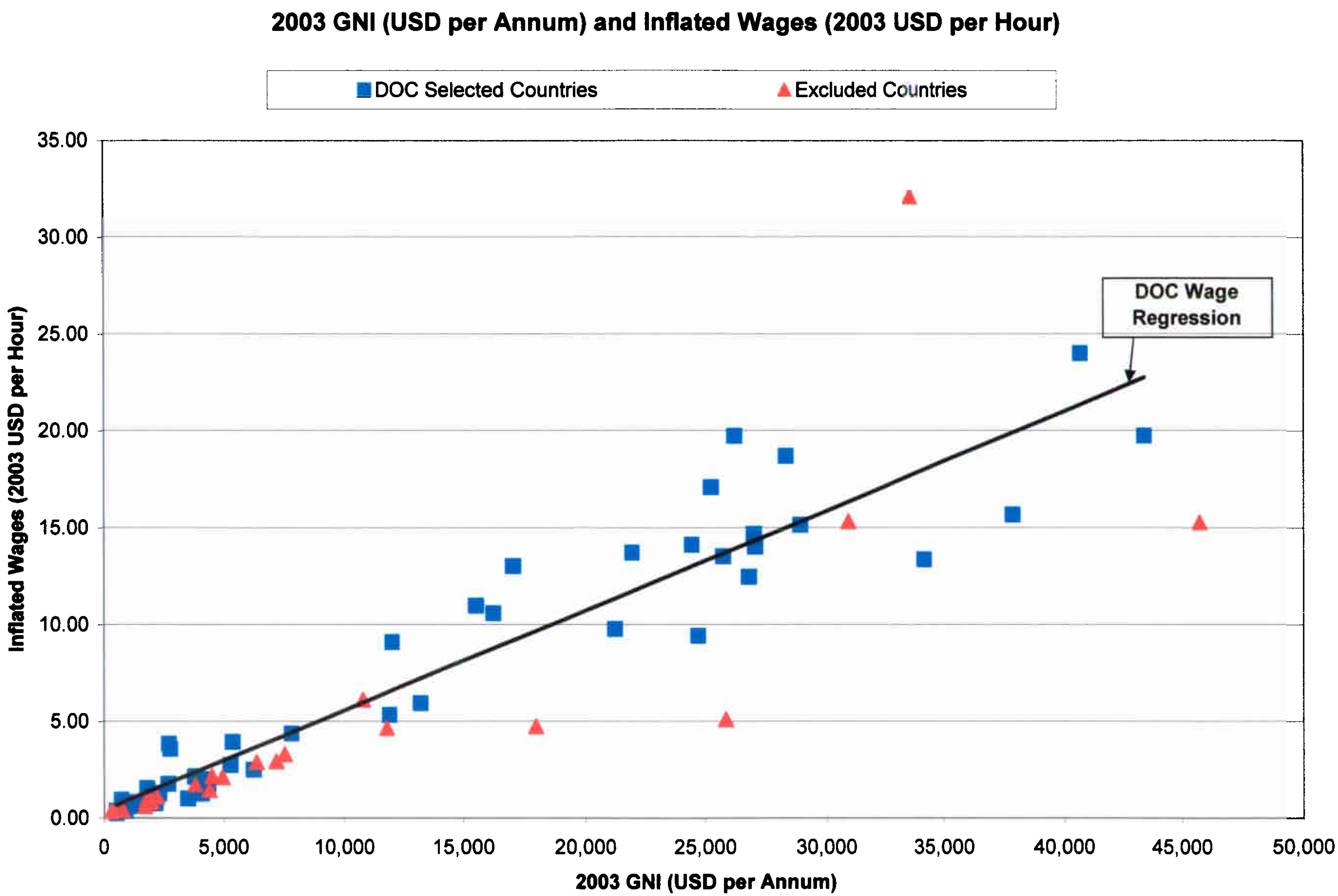
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2946.7	2946.7	370.8	0.0
Residual	73	580.1	7.9		
Total	74	3526.8			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.2101	0.4449	0.4723	0.6381	-0.6766	1.0969	-0.6766	1.0969
X Variable 1	0.000508	0.0000	19.2571	0.0000	0.0005	0.0006	0.0005	0.0006

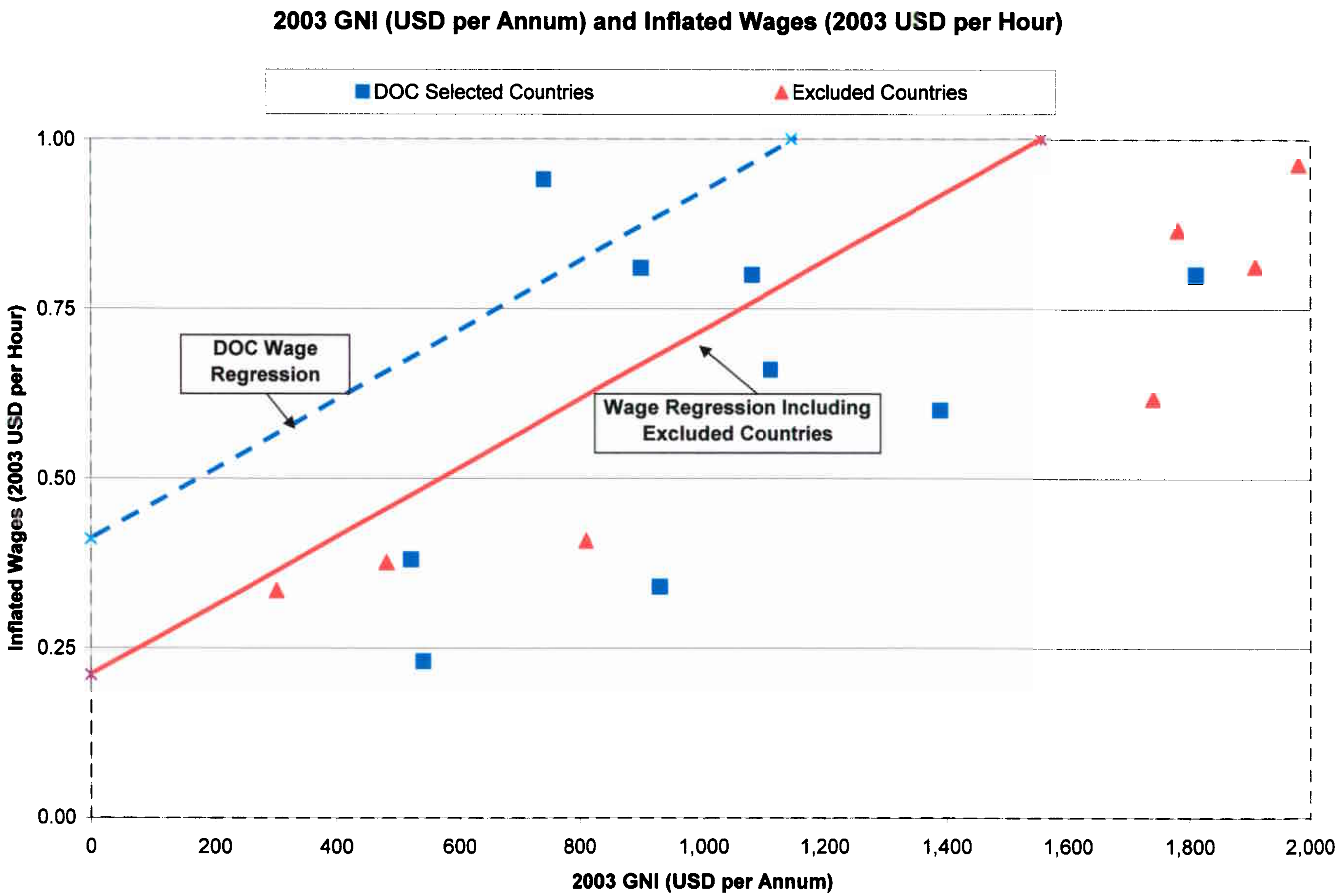
China GNI	1100		
Wage	0.7687	Formula	Intercept + GNI-Coefficient * 1,100
Wage	0.7687	Alternative Formula	Average wage - (Avg. GNI - China GNI) * GNI Coefficient 6.05 - (11,504 - 1,100) * .000508

See Attachment 5 for data.

Attachment 8



Source: ILO, World Bank, IMF and DOC website.



Source: ILO, World Bank, IMF and DOC website.

Attachment 9

Wage and Per-Capita GNI, Low and Lower-Middle Income Countries, 2003

Country	$/hr	Per Capita	World Bank
Albania	0.62	1,740	LMI
Bolivia	0.81	900	LMI
Brazil	1.76	2,720	LMI
Bulgaria	0.75	2,130	LMI
Cambodia	0.33	300	LI
Colombia	0.80	1,810	LMI
Ecuador	1.54	1,830	LMI
Egypt	0.60	1,390	LMI
El Salvador	1.25	2,340	LMI
Fiji	1.11	2,240	LMI
Guatemala	1.27	1,910	LMI
India	0.23	540	LI
Indonesia	0.41	810	LMI
Iran	0.86	2,010	LMI
Jordan	1.41	1,850	LMI
Kazakhstan	0.87	1,780	LMI
Macedonia	0.96	1,980	LMI
Mongolia	0.38	480	LI
Nicaragua	0.94	740	LI
Pakistan	0.38	520	LI
Paraguay	0.66	1,110	LMI
Peru	0.98	2,140	LMI
Philippines	0.80	1,080	LMI
Serbia and Montenegro	0.81	1,910	LMI
Sri Lanka	0.34	930	LMI
Thailand	0.78	2,190	LMI
Average		1,515	
Countries With GNIs Higher Than China		17	
Countries With GNIs Lower Than China		9	

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.7533
R Square	0.5675
Adjusted R Square	0.5495
Standard Error	0.2609
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	2.144	2.144	31.495	0.000
Residual	24	1.634	0.068		
Total	25	3.778			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.1854	0.126	1.470	0.154	-0.075	0.446	-0.075	0.446
X Variable 1	0.000427	0.000	5.612	0.00001	0.000	0.001	0.000	0.001

China GNI	1100
Wage	0.66

Countries in Bold, supporting wage rate calculations in Attachments 4 and 5.
Other countries, data files contained on Commerce website supporting 2003 sample calculations.

Attachment 10

Wage and Per-Capita GNIs Summary

	Wages		Per Capita GNI		
	DOC Included Countries	Excluded Countries	DOC Included Countries	Excluded Countries	All Countries
	$/hr	$/hr	$	$	$
1999	5.30	3.60	10,324	8,686	9,740
2000	5.03	3.95	10,561	8,858	9,967
2001	5.05	3.60	10,380	8,374	9,696
2002	5.56	3.57	10,726	7,773	9,807
2003	6.69	4.61	12,197	9,936	11,504

Source: See Attached.

Wage and Per-Capita GNIs

	1999		
	$/hr	Per Capita	World Bank Classification
Albania	0.406	980	LMI
Algeria	1.100	1,550	LMI
Argentina	4.160	7,550	UMI
Australia	11.510	20,950	HI
Austria	11.530	25,430	HI
Bahrain	1.923	9,580	UMI
Bangladesh	0.191	370	LI
Belgium	10.960	24,650	HI
Bolivia	1.130	990	LMI
Botswana	0.760	3,240	UMI
Brazil	1.980	4,350	UMI
Bulgaria	0.580	1,410	LMI
Cambodia	0.346	270	LI
Canada	11.580	20,140	HI
Chile	2.080	4,630	UMI
Colombia	1.270	2,170	LMI
Costa Rica	1.780	3,570	UMI
Croatia	2.830	4,530	UMI
Cyprus	5.833	12,220	HI
Czech Republic	1.553	5,500	UMI
Denmark	26.171	32,240	HI
Dominican Republic	1.500	1,920	LMI
Ecuador	0.770	1,360	LMI
Egypt	0.740	1,380	LMI
El Salvador	1.490	1,920	LMI
Fiji	0.962	2,430	LMI
Finland	11.370	24,730	HI
France	9.100	24,170	HI
Gambia	0.453	330	LI
Germany	15.640	25,620	HI
Greece	5.170	12,110	HI
Guatemala	1.130	1,680	LMI
Hong Kong, China	5.393	25,580	HI
Hungary	1.674	4,490	UMI
Iceland	11.949	28,580	HI
India	0.160	440	LI
Indonesia	0.220	590	LI
Iran	2.075	1,600	LMI
Ireland	7.780	21,470	HI
Israel	10.150	16,310	HI
Italy	12.762	20,350	HI
Japan	13.310	32,030	HI
Jordan	1.040	1,630	LMI
Kenya	0.440	360	LI
Korea, Republic of	6.460	8,490	HI
Kuwait	4.044	15,280	HI
Latvia	1.148	2,810	LMI
Luxembourg	11.455	44,830	HI
Macau, China	1.904	14,420	HI
Malawi	0.065	190	LI
Malaysia	1.750	3,390	UMI
Mauritius	0.820	390	UMI
Mexico	1.300	4,440	UMI
Netherlands	15.930	25,140	HI
New Zealand	8.950	13,990	HI
Nicaragua	1.020	410	LI
Norway	14.990	33,470	HI
Pakistan	0.380	470	LI
Panama	1.310	3,080	UMI
Paraguay	1.270	1,560	LMI
Peru	0.940	2,130	LMI
Philippines	1.200	1,050	LMI
Poland	1.610	4,070	UMI
Portugal	3.357	11,000	HI
Rwanda	0.442	270	LI
St. Vincent and Grenadines	1.192	2,700	LMI
Saudi Arabia	3.914	7,810	UMI
Serbia and Montenegro	0.502	1,030	LMI
Seychelles	2.888	7,290	UMI
Singapore	8.610	24,150	HI
Slovakia	1.337	3,900	UMI
Slovenia	4.130	10,000	HI
Solomon Islands	1.368	870	LI
South Africa	4.000	3,170	UMI
Spain	9.840	14,800	HI
Sri Lanka	0.310	820	LMI
Sweden	13.050	26,750	HI
Switzerland	19.980	38,380	HI
Thailand	0.820	2,010	LMI
Tonga	1.094	1,730	LMI
Trinidad and Tobago	3.390	4,750	UMI
Turkey	1.490	2,900	UMI
United Kingdom	15.360	23,590	HI
United States	13.910	31,910	HI
Uruguay	3.027	6,320	UMI
Venezuela	2.040	3,700	UMI
Zimbabwe	0.840	530	LI

	2000		
Country	$/hr	Per Capita	World Bank Classification
Albania	0.425	1,160	LMI
Algeria	0.970	1,580	LMI
Argentina	4.230	7,460	UMI
Australia	10.710	20,240	HI
Austria	9.320	25,220	HI
Bahrain	3.200	10,420	UMI
Bangladesh	0.184	380	LI
Belgium	9.880	24,540	HI
Bolivia	1.110	990	LMI
Botswana	0.760	3,300	UMI
Brazil	2.560	3,580	UMI
Bulgaria	0.560	1,520	LMI
Cambodia	0.340	280	LI
Canada	11.860	21,130	HI
Chile	2.030	4,590	UMI
Colombia	1.050	2,020	LMI
Costa Rica	1.840	3,810	UMI
Croatia	2.580	4,620	UMI
Cyprus	5.196	12,460	HI
Czech Republic	1.491	5,690	UMI
Denmark	23.401	31,450	HI
Dominican Republic	1.580	2,130	LMI
Ecuador	0.710	1,210	LMI
Egypt	0.740	1,490	LMI
El Salvador	1.150	2,000	LMI
Fiji	0.901	2,220	LMI
Finland	10.190	25,130	HI
France	8.010	24,090	HI
Gambia	0.406	320	LI
Germany	13.100	25,120	HI
Greece	4.460	11,960	HI
Guatemala	1.110	1,680	LMI
Hong Kong, China	5.381	26,830	HI
Hungary	1.641	4,620	UMI
Iceland	12.071	29,980	HI
India	0.160	450	LI
Indonesia	0.267	570	LI
Iran	2.563	1,650	LMI
Ireland	6.570	22,660	HI
Israel	10.780	16,710	HI
Italy	16.629	20,160	HI
Japan	14.170	35,620	HI
Jordan	1.050	1,710	LMI
Kenya	0.440	350	LI
Korea, Republic of	7.380	8,910	HI
Kuwait	4.417	16,280	HI
Latvia	1.162	3,200	LMI
Luxembourg	13.583	43,540	HI
Malawi	0.065	170	LI
Malaysia	1.902	3,390	UMI
Malta	4.799	9,570	HI
Mauritius	0.830	3,750	UMI
Mexico	2.060	5,070	UMI
Mongolia	0.320	400	LI
Netherlands	14.280	24,970	HI
New Zealand	7.880	12,990	HI
Nicaragua	1.060	400	LI
Norway	15.040	34,530	HI
Pakistan	0.290	440	LI
Panama	1.330	3,260	UMI
Paraguay	1.210	1,440	LMI
Peru	0.980	2,080	LMI
Philippines	1.050	1,040	LMI
Poland	2.190	4,190	UMI
Portugal	3.990	10,930	HI
Rwanda	0.398	260	LI
St. Vincent and Grenadines	1.192	2,800	LMI
Saudi Arabia	3.870	8,120	UMI
Seychelles	2.801	7,310	UMI
Singapore	9.190	24,740	HI
Slovakia	1.331	3,860	UMI
Slovenia	3.740	10,050	HI
Solomon Islands	1.419	710	LI
South Africa	3.710	3,020	UMI
Spain	7.350	15,080	HI
Sri Lanka	0.300	850	LMI
Sweden	12.150	27,140	HI
Switzerland	18.030	38,140	HI
Thailand	0.780	2,000	LMI
Trinidad and Tobago	3.510	4,930	UMI
Turkey	1.550	3,100	UMI
United Kingdom	14.730	24,430	HI
United States	14.380	34,100	HI
Uruguay	2.952	6,120	UMI
Venezuela	2.108	4,290	UMI
Zimbabwe	0.860	460	LI

Sources: Data for countries used by Commerce (not in bold) from Commerce website. Countries excluded by Commerce (in bold) extracted from ILO website on June 30, 2005, with worksheets converting such data to $/hour basis at Attachment 11. Per-Capita GNI for countries excluded by Commerce from download of such data by Commerce included on its website.

Wage and Per-Capita GNIs (cont.)

Country	2001 $/hr.	2001 Per Capita	2001 World Bank Classification
Albania	0.510	1,340	LMI
Algeria	0.99	1,650	LMI
Argentina	4.29	6,940	UMI
Australia	10	19,900	HI
Austria	9.27	23,940	HI
Bahrain	2.978	10,590	HI
Bangladesh	0.175	380	LI
Belgium	9.82	23,850	HI
Bolivia	0.9	950	LMI
Botswana	0.74	3,100	UMI
Brazil	1.87	3,070	LMI
Bulgaria	0.56	1,650	LMI
Cambodia	0.323	280	LI
Canada	11.99	21,930	HI
Chile	1.75	4,590	UMI
Colombia	1.03	1,890	LMI
Costa Rica	2.03	4,060	UMI
Croatia	2.79	4,550	UMI
Cyprus	5.788	12,320	HI
Czech Republic	1.936	5,650	UMI
Denmark	23.942	30,480	HI
Dominican Republic	1.67	2,230	LMI
Ecuador	1.86	1,080	LMI
Egypt	0.64	1,530	LMI
El Salvador	1.2	2,040	LMI
Fiji	0.877	2,090	LMI
Finland	10.37	23,780	HI
France	7.54	22,730	HI
Gambia	0.357	310	LI
Germany	12.88	23,560	HI
Greece	4.41	11,430	HI
Guatemala	1.18	1,680	LMI
Guinea	0.712	420	LI
Hong Kong, China	5.491	25,790	HI
Hungary	1.850	4,620	UMI
Iceland	10.830	28,430	HI
India	0.15	460	LI
Indonesia	0.288	680	LMI
Iran	3.010	1,680	LMI
Ireland	9.16	22,850	HI
Israel	11.2	16,750	HI
Japan	12.75	35,610	HI
Jordan	1.00	1,750	LMI
Kenya	0.48	350	LI
Korea	6.87	9,460	HI
Kuwait	4.492	16,760	HI
Latvia	1.164	3,520	UMI
Luxembourg	14.097	43,150	HI
Malaysia	2.1	3,330	UMI
Malta	4.890	9,690	HI
Mauritius	0.79	3,830	UMI
Mexico	2.49	5,530	UMI
Mongolia	0.333	410	LI
Netherlands	14.57	24,330	HI
New Zealand	7.36	13,250	HI
Nicaragua	1.27	457	LI
Norway	14.15	35,630	HI
Pakistan	0.26	420	LI
Panama	1.33	3,260	UMI
Paraguay	1.1	1,350	LMI
Peru	0.97	1,980	LMI
Philippines	0.79	1,030	LMI
Poland	2.45	4,230	UMI
Portugal	4.295	10,620	HI
Rwanda	0.362	240	LI
St. Vincent and Grenadines	1.228	2,940	UMI
Saudi Arabia	3.827	8,420	HI
Seychelles	2.887	7,220	UMI
Singapore	9.07	21,500	HI
Slovakia	1.391	3,860	UMI
Slovenia	3.83	9,760	HI
Solomon Islands	1.425	610	LI
South Africa	2.68	2,820	UMI
Spain	9.34	14,300	HI
Sri Lanka	0.3	880	LMI
Sweden	11.12	25,400	HI
Switzerland	18.24	38,330	HI
Thailand	0.71	1,940	LMI
Trinidad and Tobago	3.74	5,960	UMI
Turkey	1.22	2,530	UMI
United Kingdom	15.11	25,120	HI
United States	14.83	34,280	HI
Uruguay	2.685	5,630	UMI
Venezuela	2.230	4,730	UMI
Zimbabwe	1.35	480	LI

Country	2002 $/hr	2002 Per capita	2002 World Bank Classification*
Albania	0.53	1,450	LMI
Argentina	1.92	4,220	UMI
Australia	11.12	19,530	HI
Austria	10.25	23,860	HI
Bahrain	3.16	11,260	HI
Belgium	11.10	22,940	HI
Bolivia	0.83	910	LMI
Botswana	0.73	2,990	UMI
Brazil	1.66	2,830	LMI
Bulgaria	0.61	1,790	LMI
Cambodia	0.33	300	LI
Canada	12.17	22,390	HI
Chile	1.66	4,350	UMI
Colombia	0.73	1,810	LMI
Costa Rica	2.04	4,070	UMI
Croatia	3.18	4,620	UMI
Czech Republic	1.97	5,480	UMI
Denmark	26.31	30,260	HI
Dominican Republic	1.61	2,310	LMI
Ecuador	1.43	1,490	LMI
Egypt	0.74	1,470	LMI
El Salvador	1.21	2,080	LMI
Fiji	0.92	2,080	LMI
Finland	11.59	23,890	HI
France	7.69	22,240	HI
Gambia	0.30	270	LI
Germany	13.90	22,740	HI
Greece	4.80	11,660	HI
Guatemala	1.22	1,750	LMI
Hong Kong	7.98	24,690	HI
Hungary	2.32	5,290	UMI
Iceland	10.10	27,960	HI
India	0.21	470	LI
Indonesia	0.35	710	LMI
Iran	1.21	1,720	LMI
Ireland	11.61	23,030	HI
Israel	10.10	16,020	HI
Japan	12.33	34,010	HI
Jordan	1.38	1,760	LMI
Kazakstan*	0.57	1,520	LMI
Kenya	0.49	360	LI
Korea	7.74	11,280	HI
Kuwait	4.60	16,340	HI
Latvia	1.23	3,480	UMI
Luxembourg	12.37	39,470	HI
Macedonia	0.81	1,710	LMI
Malaysia	2.14	3,550	UMI
Malta	5.31	9,260	HI
Mauritius	1.07	3,860	UMI
Mexico	2.60	5,940	UMI
Mongolia	0.32	430	LI
Netherlands	15.83	23,390	HI
New Zealand	8.36	13,250	HI
Nicaragua	0.94	720	LI
Norway	17.07	38,730	HI
Pakistan	0.36	420	LI
Panama	1.80	4,020	UMI
Paraguay	0.69	1,180	LMI
Peru	1.00	2,020	LMI
Philippines	0.81	1,030	LMI
Poland	2.44	4,670	UMI
Portugal	3.98	10,720	HI
Rwanda	0.35	230	LI
Saudi Arabia	3.84	8,530	HI
Serbia and Montenegro	0.63	1,400	LMI
Seychelles	3.14	6,910	UMI
Singapore	9.18	21,180	HI
Slovakia	1.59	3,970	UMI
Slovenia	4.26	10,200	HI
South Africa	2.58	2,630	UMI
Spain	10.36	14,580	HI
Sri Lanka	0.33	850	LMI
Sweden	12.18	25,970	HI
Switzerland	20.64	36,170	HI
Thailand	0.74	2,000	LMI
Trinidad and Tobago	4.23	6,600	UMI
Turkey	2.82	2,510	UMI
United Kingdom	16.54	25,490	HI
United States	15.30	35,400	HI
Uruguay	2.06	4,340	UMI
Venezuela	1.79	4,080	UMI
West Bank & Gaza	1.85	1,110	LMI

Sources: Data for countries used by Commerce (not in bold) from Commerce website. Countries excluded by Commerce (in bold) extracted from ILO website on June 30, 2005, with worksheets converting such data to $/hour basis at Attachment 11. Per-Capita GNI for countries excluded by Commerce from download of such data by Commerce included on its website.

Wage and Per-Capita GNIs (cont.)

	2003		
Country	$/hr	Per Capita	World Bank Classification
Albania	0.62	1,740	LMI
Argentina	2.12	3,810	UMI
Australia	13.70	21,950	HI
Austria	12.44	26,810	HI
Belgium	13.50	25,760	HI
Bolivia	0.81	900	LMI
Botswana	1.00	3,530	UMI
Brazil	1.76	2,720	LMI
Bulgaria	0.75	2,130	LMI
Cambodia	0.33	300	LI
Canada	14.10	24,470	HI
Chile	1.70	4,360	UMI
Colombia	0.80	1,810	LMI
Costa Rica	2.00	4,300	UMI
Croatia	3.92	5,370	UMI
Czech Republic	2.93	7,150	UMI
Denmark	32.10	33,570	HI
Ecuador	1.54	1,830	LMI
Egypt	0.60	1,390	LMI
El Salvador	1.25	2,340	LMI
Fiji	1.11	2,240	LMI
Finland	14.00	27,060	HI
France	9.40	24,730	HI
Germany	17.06	25,270	HI
Greece	5.92	13,230	HI
Guatemala	1.27	1,910	LMI
Hong Kong	5.10	25,860	HI
Hungary	2.88	6,350	UMI
Iceland	15.31	30,910	HI
India	0.23	540	LI
Indonesia	0.41	810	LMI
Iran	0.86	2,010	LMI
Ireland	14.66	27,010	HI
Israel	10.56	16,240	HI
Japan	13.34	34,180	HI
Jordan	1.41	1,850	LMI
Kazakhstan*	0.87	1,780	LMI
Korea, Republic	9.07	12,030	HI
Kuwait	4.73	17,960	HI
Latvia	1.45	4,400	UMI
Lithuania*	2.16	4,500	UMI
Luxembourg	15.26	45,740	HI
Macedonia	0.96	1,980	LMI
Malaysia	2.16	3,880	UMI
Malta	6.11	10,780	HI
Mauritius	1.25	4,100	UMI
Mexico	2.49	6,230	UMI
Mongolia	0.38	480	LI
Netherlands	19.71	26,230	HI
New Zealand	10.96	15,530	HI
Nicaragua	0.94	740	LI
Norway	19.73	43,400	HI
Pakistan	0.38	520	LI
Panama	1.70	4,060	UMI
Paraguay	0.66	1,110	LMI
Peru	0.98	2,140	LMI
Philippines	0.80	1,080	LMI
Poland	2.73	5,280	UMI
Portugal	4.64	11,800	HI
Serbia and Montenegro	0.81	1,910	LMI
Seychelles	3.29	7,490	UMI
Singapore	9.76	21,230	HI
Slovakia	2.11	4,940	UMI
Slovenia	5.31	11,920	HI
South Africa	3.82	2,750	UMI
Spain	13.00	17,040	HI
Sri Lanka	0.34	930	LMI
Sweden	15.12	28,910	HI
Switzerland	23.98	40,680	HI
Thailand	0.78	2,190	LMI
Trinidad and Tobago	4.35	7,790	UMI
Turkey	3.56	2,800	UMI
United Kingdom	18.68	28,320	HI
United States	15.65	37,870	HI
Uruguay	1.72	3,820	UMI

Sources: Data for countries used by Commerce (not in bold) from Commerce website. Countries excluded by Commerce (in bold) extracted from ILO website on June 30, 2005, with worksheets converting such data to $/hour basis at Attachment 11. Per-Capita GNI for countries excluded by Commerce from download of such data by Commerce included on its website

Attachment 11

Wage Rate and Per Capita GNI Data for Excluded Countries -- 1999 Base Year

Country	Reported Wage Rate	Reporting Year	Currency	Measuring Unit	Hours per Measuring Unit	Worker Coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/ hour	Inflator to 2001	Home Currency/ hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr	2001 Per Capita GNI ($)
Albania	10734	1999	Leks	month	192	Employees	Men and Women	Total	5B	55.91	1.00	55.91	0.0073	0.41	980.00
Bahrain	227	1999	Dinars (1,000)	month	192	Employees	Men and Women	Total	5B	1,182.29	1.00	1,182.29	0.0016	1.92	9,580.00
Bangladesh	61.9	1996	Taka	day	8	Skilled	Men and Women	Total	5B	7.74	1.21	9.38	0.0204	0.19	370.00
Cambodia	243000	1998	Riels	month	192	Employees	Men and Women	Total	5B	1,265.63	1.04	1,316.35	0.0003	0.35	270.00
Cyprus	139.19	1999	Pounds	week	44	Wage earners	Men and Women	Total	5B	3.16	1.00	3.16	1.8440	5.83	12,220.00
Czech Republic	10294	1999	Koruny	month	192	Wage earners	Men and Women	Total	5B	53.61	1.00	53.61	0.0290	1.55	5,500.00
Denmark	182.34	1999	Kroner	hour	1	Employees	Men and Women	Total	5B	182.34	1.00	182.34	0.1435	26.17	32,240.00
Fiji	15.15	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	1.89	1.00	1.89	0.5078	0.96	2,430.00
Gambia	969.69	1998	Dalasis	month	192	Employees	Men and Women	Total	5B	5.05	1.02	5.16	0.0878	0.45	330.00
Hong Kong, China	334.7	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	41.84	1.00	41.84	0.1289	5.39	25,580.00
Hungary	76099	1999	Forint	month	192	Employees	Men and Women	Total	5B	396.35	1.00	396.35	0.0042	1.67	4,490.00
Iceland	864	1999	Kronur	hour	1	Employees	Men and Women	Total	5B	864.00	1.00	864.00	0.0138	11.95	28,580.00
Indonesia	75.3	1999	Rupiahs (1,000)	week	44	Wage earners	Men and Women	Total	5B	1,711.36	1.00	1,711.36	0.0001	0.22	590.00
Iran, Islamic Rep. of	698899	1999	Rials	month	192	Employees	Men and Women	Total	5B	3,640.10	1.00	3,640.10	0.0006	2.08	1,600.00
Italy	2614	1995	Euros	month	192	Employees	Men and Women	Total	5B	13.61	1.00	13.61	0.9374	12.76	20,350.00
Kuwait	1.231	1999	Dinars	hour	1	Employees	Men and Women	Total	5B	1.23	1.00	1.23	3.2850	4.04	15,280.00
Latvia	128.97	1999	Lats	month	192	Employees	Men and Women	Total	5B	0.67	1.00	0.67	1.7092	1.15	2,810.00
Luxembourg	12.22	1999	Euros	hour	1	Wage earners	Men and Women	Total	5B	12.22	1.00	12.22	0.9374	11.46	44,830.00
Macau, China	2921	1999	Patacas	month	192	Total employment	Men and Women	Total	5B	15.21	1.00	15.21	0.1251	1.90	14,420.00
Malawi	195.79	1995	Kwacha	month	192	Employees	Men and Women	Total	5B	1.02	2.82	2.88	0.0225	0.06	190.00
Portugal	718	1999	Euros	hour	1	Wage earners	Men and Women	Total	5B	718.00	1.00	718.00	0.0047	3.36	11,000.00
Rwanda	27659	1997	Francs	month	192	Employees	Men and Women	Total	5B	144.06	1.04	149.32	0.0030	0.44	270.00
Saint Vincent and the Grenadines	25.75	1999	Dollars, EC	day	8	Employees	Men and Women	Total	5B	3.22	1.00	3.22	0.3704	1.19	2,700.00
Saudi Arabia	657	1997	Riyals	week	44	Employees	Men and Women	Total	5B	14.93	0.98	14.68	0.2667	3.91	7,810.00
Serbia and Montenegro	1053	1999	New Dinars	month	192	Employees	Men and Women	Total	5B	5.48	1.00	5.48	0.0916	0.50	1,030.00
Seychelles	2962	1999	Rupees	month	192	Employees	Men and Women	Total	5B	15.43	1.00	15.43	0.1872	2.89	7,290.00
Slovakia	10758	1999	Koruny	month	192	Employees	Men and Women	Total	5B	56.03	1.00	56.03	0.0239	1.34	3,900.00
Solomon Islands	987	1996	Dollars	month	192	Employees	Men and Women	Total	5B	5.14	1.31	6.75	0.2029	1.37	870.00
Tonga	66.6	1994	Pa'anga	week	44	Employees	Men and Women	Total	5B	1.51	1.16	1.75	0.6254	1.09	1,730.00
Uruguay	24.45	1996	Pesos	hour	1	Employees	Men and Women	Total	5B	24.45	1.40	34.30	0.0882	3.03	6,320.00
Venezuela	141122	1997	Bolívares	month	192	Employees	Men and Women	Total	5B	735.01	1.68	1,233.24	0.0017	2.04	3,700.00

Sources: Wage rate data from June 30, 2005 extraction of data from ILO website. CPI, per-capita GNI, and exchange rates from Commerce extraction of data from the IMF and World Bank.
See http://ia.ita.doc.gov/wages/03wages/03wages.html

Wage Rate and Per Capita GNI Data for Excluded Countries -- 2000 Base Year

Country	Reported Wage Rate	Reporting Year	Currency	Measuring Unit	Hours per Measuring Unit	Worker Coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/hour	Inflator to 2000	Home Currency/hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr	2000 Per Capita GNI ($)
Albania	11,708.00	2000	Leks	Earnings per month	192	Employees	Men and Women	Total	5B	60.98	1.00	60.98	0.00696	0.42	1,160
Bahrain	231.00	2000	Dinars	Earnings per month	192	Employees	Men and Women	Total	5B	1.20	1.00	1.20	2.65957	3.20	10,420
Bangladesh	61.90	1996	Taka	Wage rates per day	8	Skilled	Men and Women	Total	5B	7.74	1.24	9.59	0.01919	0.18	380
Cambodia	243,000.00	1998	Riels	Wage rates per month	192	Employees	Men and Women	Total	5B	1,265.63	1.03	1,305.93	0.00026	0.34	280
Hong Kong, China	335.40	2000	Dollars	Wage rates per day	8	Wage earners	Men and Women	Total	5B	41.93	1.00	41.93	0.12835	5.38	26,830
Cyprus	141.93	2000	Pounds	Earnings per week	44	Wage earners	Men and Women	Total	5B	3.23	1.00	3.23	1.61069	5.20	12,460
Czech Republic	11,005.00	2000	Koruny	Earnings per month	192	Wage earners	Men and Women	Total	5B	57.32	1.00	57.32	0.02602	1.49	5,690
Denmark	188.59	2000	Kroner	Earnings per hour	1	Employees	Men and Women	Total	5B	188.59	1.00	188.59	0.12409	23.40	31,450
Fiji	15.15	1999	Dollars	Wage rates per day	8	Wage earners	Men and Women	Total	5B	1.89	1.01	1.91	0.47067	0.90	2,220
Gambia	969.69	1998	Dalasis	Earnings per month	192	Employees	Men and Women	Total	5B	5.05	1.02	5.17	0.07858	0.41	320
Hungary	88,551.00	2000	Forint	Earnings per month	192	Employees	Men and Women	Total	5B	461.20	1.00	461.20	0.00356	1.64	4,620
Iceland	945.00	2000	Kronur	Earnings per hour	1	Employees	Men and Women	Total	5B	945.00	1.00	945.00	0.01277	12.07	29,980
Indonesia	98.00	2000	Rupiahs (1,000)	Wage rates per week	44	Wage earners	Men and Women	Total	5B	2,227.27	1.00	2,227.27	0.00012	0.27	570
Iran, Islamic Rep. of	867,526.00	2000	Rials	Earnings per month	192	Employees	Men and Women	Total	5B	4,518.36	1.00	4,518.36	0.00057	2.56	1,650
Italy	2,614.00	1995	Euros	Earnings per month	192	Employees	Men and Women	Total	5B	13.61	1.13	15.35	1.08319	16.63	20,160
Kuwait	1.36	2000	Dinars	Earnings per hour	1	Employees	Men and Women	Total	5B	1.36	1.00	1.36	3.25998	4.42	16,280
Latvia	135.13	2000	Lats	Earnings per month	192	Employees	Men and Women	Total	5B	0.70	1.00	0.70	1.65079	1.16	3,200
Luxembourg	12.54	2000	Euros	Earnings per hour	1	Wage earners	Men and Women	Total	5B	12.54	1.00	12.54	1.08319	13.58	43,540
Malawi	195.79	1995	Kwacha	Earnings per month	192	Employees	Men and Women	Total	5B	1.02	3.66	3.73	0.01754	0.07	170
Malta	2.10	2000	Pounds	Earnings per hour	1	Total employment	Men and Women	Total	5B	2.10	1.00	2.10	2.28513	4.80	9,570
Mongolia	66.00	2000	Tughriks (1,000)	Earnings per month	192	Employees	Men and Women	Total	5B	343.75	1.00	343.75	0.00093	0.32	400
Portugal	718.00	1999	Pte	Earnings per hour	1	Wage earners	Men and Women	Total	5B	718.00	1.03	738.44	0.00540	3.99	10,930
Rwanda	27,659.00	1997	Francs	Earnings per month	192	Employees	Men and Women	Total	5B	144.06	1.08	155.73	0.00255	0.40	260
Saint Vincent and the Grenadines	25.75	2000	Dollars, EC	Wage rates per day	8	Employees	Men and Women	Total	5B	3.22	1.00	3.22	0.37037	1.19	2,800
Saudi Arabia	657.00	1997	Riyals	Earnings per week	44	Employees	Men and Women	Total	5B	14.93	0.97	14.51	0.26667	3.87	8,120
Seychelles	3,067.00	2000	Rupees	Earnings per month	192	Employees	Men and Women	Total	5B	15.97	1.00	15.97	0.17532	2.80	7,310
Slovakia	11,722.00	2000	Koruny	Earnings per month	192	Employees	Men and Women	Total	5B	61.05	1.00	61.05	0.02181	1.33	3,860
Solomon Islands	987.00	1996	Dollars	Earnings per month	192	Employees	Men and Women	Total	5B	5.14	1.40	7.22	0.19649	1.42	710
Uruguay	6,855.00	2000	Pesos	Earnings per month	192	Employees	Men and Women	Total	5B	35.70	1.00	35.70	0.08269	2.95	6,120
Venezuela	141,122.00	1997	Bolivares	Earnings per month	192	Employees	Men and Women	Total	5B	735.01	1.95	1,433.09	0.00147	2.11	4,290

Sources: Wage rate data from June 30, 2005 extraction of data from ILO website. CPI, per-capita GNI, and exchange rates from Commerce extraction of data from the IMF and World Bank.
See http://ia.ita.doc.gov/wages/03wages/03wages.html

Wage Rate and Per Capita GNI Data for Excluded Countries -- 2001 Base Year

Country	Reported Wage Rate	Reporting Year	Currency	Measuring Unit	Hours per Measuring Unit	Worker Coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/ hour	Inflator to 2001	Home Currency/ hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr	2001 Per Capita GNI ($)
Albania	14056	2001	Leks	month	192	Employees	Men and Women	Total	5B	73.21	1.000	73.208	0.00697	0.510	1,340
Armenia	35848	2001	Dram	month	192	Employees	Men and Women	Total	5B	186.71	1.000	186.708	0.00180	0.336	700
Bahrain	215	2001	Dinars	month	192	Employees	Men and Women	Total	5B	1.12	1.000	1.120	2.65957	2.978	10,590
Bangladesh	61.9	1996	Taka	day	8	Skilled	Men and Women	Total	5B	7.74	1.264	9.779	0.01793	0.175	380
Cambodia	243000	2001	Riels	month	192	Employees	Men and Women	Total	5B	1,265.63	1.000	1265.625	0.00026	0.323	280
Cyprus	3.72	2001	Pounds	hour	1	Wage earners	Men and Women	Total	5B	3.72	1.000	3.720	1.55586	5.788	12,320
Czech Republic	14130	2001	Koruny	month	192	Wage earners	Men and Women	Total	5B	73.59	1.000	73.59	0.02631	1.936	5,650
Denmark	199.1	2001	Kroner	hour	1	Employees	Men and Women	Total	5B	199.10	1.000	199.10	0.12025	23.942	30,480
Eritrea	478.48	1996	Nakfa	month	192	Employees	Men and Women	Total	5B	2.49	n/a	n/a	0.09003	n/a	200
Fiji	15.15	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	1.89	1.054	2.00	0.43937	0.877	2,090
Gambia	969.69	1998	Dalasis	month	192	Employees	Men and Women	Total	5B	5.05	1.106	5.59	0.06385	0.357	310
Guinea	153000	1996	Francs	month	192	Employees	Men and Women	Total	5B	796.88	1.743	1,389.09	0.00051	0.712	420
Hong Kong, China	342.6	2001	Dollars	day	8	Wage earners	Men and Women	Total	5B	42.83	1.000	42.83	0.12823	5.491	25,790
Hungary	101700	2001	Forint	month	192	Employees	Men and Women	Total	5B	529.69	1.000	529.69	0.00349	1.850	4,620
Iceland	1049	2001	Kronur	hour	1	Employees	Men and Women	Total	5B	1,049.00	1.000	1,049.00	0.01032	10.83	28430
Indonesia	129.2	2001	Rupiahs (1,000)	week	44	Wage earners	Men and Women	Total	5B	2,936.36	1.000	2,936.36	0.00010	0.288	680
Iran, Islamic Rep. of	1014285	2001	Rials	month	192	Employees	Men and Women	Total	5B	5,282.73	1.000	5,282.73	0.00057	3.010	1,680
Kuwait	1.355	2000	Dinars	hour	1	Employees	Men and Women	Total	5B	1.36	1.017	1.38	3.26074	4.492	16,760
Latvia	140.34	2001	Lats	month	192	Employees	Men and Women	Total	5B	0.73	1.000	0.73	1.59279	1.164	3,520
Luxembourg	12.62	2001	Euros	hour	1	Wage earners	Men and Women	Total	5B	12.62	1.000	12.62	1.11707	14.097	43,150
Macau, China	2760	2001	Patacas	month	192	Total employment	Men and Women	Total	5B	14.38	1.000	14.38	n/a	n/a	14,600
Malta	2.2	2001	Pounds	hour	1	Total employment	Men and Women	Total	5B	2.20	1.000	2.20	2.22258	4.890	9,690
Mongolia	66	2000	Tughriks (1,000)	month	192	Employees	Men and Women	Total	5B	343.75	1.063	365.33	0.00091	0.333	410
Portugal	718	1999	Pte	hour	1	Wage earners	Men and Women	Total	5B	718.00	1.074	770.89	0.00557	4.295	10,620
Rwanda	27659	1997	Francs	month	192	Employees	Men and Women	Total	5B	144.06	1.113	160.38	0.00226	0.362	240
Saint Vincent and the Grenadines	26.52	2001	Dollars, EC	day	8	Employees	Men and Women	Total	5B	3.32	1.000	3.32	0.37037	1.228	2,940
Saudi Arabia	657	1997	Riyals	week	44	Employees	Men and Women	Total	5B	14.93	0.961	14.35	0.26667	3.827	8,420
Serbia and Montenegro	4786	2001	New Dinars	month	192	Employees	Men and Women	Total	5B	24.93	1.000	24.93	n/a	n/a	970
Seychelles	3235	2001	Rupees	month	192	Employees	Men and Women	Total	5B	16.85	1.000	16.85	0.17132	2.887	7,220
Slovakia	12908	2001	Koruny	month	192	Employees	Men and Women	Total	5B	67.23	1.000	67.23	0.02069	1.391	3,860
Solomon Islands	987	1996	Dollars	month	192	Employees	Men and Women	Total	5B	5.14	1.502	7.72	0.18457	1.425	610
Uruguay	6856	2001	Pesos	month	192	Employees	Men and Women	Total	5B	35.71	1.000	35.71	0.07519	2.685	5,630
Venezuela	141122	1997	Bolívares	month	192	Employees	Men and Women	Total	5B	735.01	2.194	1,612.72	0.00138	2.230	4,730
West bank and Gaza strip	68	2001	New Shekels	day	8	Employees	Men and Women	Total	5B	8.50	1.000	8.50	n/a	n/a	1,370

Sources: Wage rate data from June 30, 2005 extraction of data from ILO website. CPI, per-capita GNI, and exchange rates from Commerce extraction of data from the IMF and World Bank.
See http://ia.ita.doc.gov/wages/03wages/03wages.html

Euro exchange rate from Federal Reserve (http://www.federalreserve.gov/releases/g5a/20020102/).

Wage Rate and Per Capita GNI Data for Excluded Countries -- 2001 Base Year

Country	Reported Wage Rate	Reporting Year	Currency	Measuring Unit	Hours per Measuring Unit	Worker Coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/hour	Inflator to 2001	Home Currency/hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr	2001 Per Capita GNI ($)
Albania	14056	2001	Leks	month	192	Employees	Men and Women	Total	5B	73.21	1.000	73.208	0.00697	0.510	1,340
Armenia	35848	2001	Dram	month	192	Employees	Men and Women	Total	5B	186.71	1.000	186.708	0.00180	0.336	700
Bahrain	215	2001	Dinars	month	192	Employees	Men and Women	Total	5B	1.12	1.000	1.120	2.65957	2.978	10,590
Bangladesh	61.9	1996	Taka	day	8	Skilled	Men and Women	Total	5B	7.74	1.264	9.779	0.01793	0.175	380
Cambodia	243000	2001	Riels	month	192	Employees	Men and Women	Total	5B	1,265.63	1.000	1265.625	0.00026	0.323	280
Cyprus	3.72	2001	Pounds	hour	1	Wage earners	Men and Women	Total	5B	3.72	1.000	3.720	1.55586	5.788	12,320
Czech Republic	14130	2001	Koruny	month	192	Wage earners	Men and Women	Total	5B	73.59	1.000	73.59	0.02631	1.936	5,650
Denmark	199.1	2001	Kroner	hour	1	Employees	Men and Women	Total	5B	199.10	1.000	199.10	0.12025	23.942	30,480
Eritrea	478.48	1996	Nakfa	month	192	Employees	Men and Women	Total	5B	2.49	n/a	n/a	0.09003	n/a	200
Fiji	15.15	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	1.89	1.054	2.00	0.43937	0.877	2,090
Gambia	969.69	1998	Dalasis	month	192	Employees	Men and Women	Total	5B	5.05	1.106	5.59	0.06385	0.357	310
Guinea	153000	1996	Francs	month	192	Employees	Men and Women	Total	5B	796.88	1.743	1,389.09	0.00051	0.712	420
Hong Kong, China	342.6	2001	Dollars	day	8	Wage earners	Men and Women	Total	5B	42.83	1.000	42.83	0.12823	5.491	25,790
Hungary	101700	2001	Forint	month	192	Employees	Men and Women	Total	5B	529.69	1.000	529.69	0.00349	1.850	4,620
Iceland	1049	2001	Kronur	hour	1	Employees	Men and Women	Total	5B	1,049.00	1.000	1,049.00	0.01032	10.83	28430
Indonesia	129.2	2001	Rupiahs (1,000)	week	44	Wage earners	Men and Women	Total	5B	2,936.36	1.000	2,936.36	0.00010	0.288	680
Iran, Islamic Rep. of	1014285	2001	Rials	month	192	Employees	Men and Women	Total	5B	5,282.73	1.000	5,282.73	0.00057	3.010	1,680
Kuwait	1.355	2000	Dinars	hour	1	Employees	Men and Women	Total	5B	1.36	1.017	1.38	3.26074	4.492	16,760
Latvia	140.34	2001	Lats	month	192	Employees	Men and Women	Total	5B	0.73	1.000	0.73	1.59279	1.164	3,520
Luxembourg	12.62	2001	Euros	hour	1	Wage earners	Men and Women	Total	5B	12.62	1.000	12.62	1.11707	14.097	43,150
Macau, China	2760	2001	Patacas	month	192	Total employment	Men and Women	Total	5B	14.38	1.000	14.38	n/a	n/a	14,600
Malta	2.2	2001	Pounds	hour	1	Total employment	Men and Women	Total	5B	2.20	1.000	2.20	2.22258	4.890	9,690
Mongolia	66	2000	Tughriks (1,000)	month	192	Employees	Men and Women	Total	5B	343.75	1.063	365.33	0.00091	0.333	410
Portugal	718	1999	Pte	hour	1	Wage earners	Men and Women	Total	5B	718.00	1.074	770.89	0.00557	4.295	10,620
Rwanda	27659	1997	Francs	month	192	Employees	Men and Women	Total	5B	144.06	1.113	160.38	0.00226	0.362	240
Saint Vincent and the Grenadines	26.52	2001	Dollars, EC	day	8	Employees	Men and Women	Total	5B	3.32	1.000	3.32	0.37037	1.228	2,940
Saudi Arabia	657	1997	Riyals	week	44	Employees	Men and Women	Total	5B	14.93	0.961	14.35	0.26667	3.827	8,420
Serbia and Montenegro	4786	2001	New Dinars	month	192	Employees	Men and Women	Total	5B	24.93	1.000	24.93	n/a	n/a	970
Seychelles	3235	2001	Rupees	month	192	Employees	Men and Women	Total	5B	16.85	1.000	16.85	0.17132	2.887	7,220
Slovakia	12908	2001	Koruny	month	192	Employees	Men and Women	Total	5B	67.23	1.000	67.23	0.02069	1.391	3,860
Solomon Islands	987	1996	Dollars	month	192	Employees	Men and Women	Total	5B	5.14	1.502	7.72	0.18457	1.425	610
Uruguay	6856	2001	Pesos	month	192	Employees	Men and Women	Total	5B	35.71	1.000	35.71	0.07519	2.685	5,630
Venezuela	141122	1997	Bolívares	month	192	Employees	Men and Women	Total	5B	735.01	2.194	1,612.72	0.00138	2.230	4,730
West bank and Gaza strip	68	2001	New Shekels	day	8	Employees	Men and Women	Total	5B	8.50	1.000	8.50	n/a	n/a	1,370

Sources: Wage rate data from June 30, 2005 extraction of data from ILO website. CPI, per-capita GNI, and exchange rates from Commerce extraction of data from the IMF and World Bank.
See http://ia.ita.doc.gov/wages/03wages/03wages.html

Selection Criteria for Countries Excluded by Commerce for its 2002 Base Year NME Wage Rate Calculation

Country	Sex	Sub-Classification (Industry)	Worker Coverage	Reported Wage Rate	Measuring Currency	Measuring Unit	Hours per Measuring Unit	Hourly Wages, Home Currency	Reporting Year	2002 Per Capita GNI Available*
Albania	Men & Women	Total	Employees	14,334.0	leks	month	192	74.656	2002	1,420
Bahrain	Men & Women	Total	Employees	228.0	Dinars	month	192	1.188	2002	11,260
Cambodia	Men & Women	Total	Employees	243,000.0	Rials	month	192	1265.625	2001	290
Czech	Men & Women	Total	Employees	12,327.0	koruny	month	192	64.203	2002	5,490
Denmark	Men & Women	Total	Employees	207.0	kroner	hour	1	207.020	2002	30,260
Fiji	Men & Women	Total	Wage Earners	14.4	Dollars	day	8	1.800	1999	2,080
Gambia	Men & Women	Total	Employees	969.7	dalasis	month	192	5.050	1998	310
Hong Kong	Men & Women	Total	Wage Earners	326.1	HK Dollars	day	8	40.763	2002	24,500
Hungary	Men & Women	Total	Employees	114,297.0	forint	month	192	595.297	2002	5,240
Iceland	Men & Women	Total	Employees	176,800.0	Kronur	month	192	920.833	2002	27,960
Indonesia	Men & Women	Total	Wage Earners	129,200.0	rupiahs	week	44	2936.364	2001	710
Iran	Men & Women	Total	Employees	1,014,285.0	rials	month	192	5282.734	2001	1,790
Kazakstan	Men & Women	Total	Employees	22,130.0	tenges	month	192	115.260	2002	1,520
Kuwait	Men & Women	Total	Employees	1.4	dinars	hour	1	1.355	2000	16,340
Latvia	Men & Women	Total	Employees	145.5	lats	month	192	0.758	2002	3,490
Luxembourg	Men & Women	Total	Wage Earners	13.1	Euros	hour	1	13.100	2002	39,470
Macedonia	Men & Women	Total	Employees	9,944.0	denais	month	192	51.792	2002	1,710
Malta	Men & Women	Total	Total Employment	2.3	Pounds	hour	1	2.300	2002	9,260
Moldova	Men & Women	Total	Employees	971.8	lei	month	192	5.061	2002	470
Mongolia	Men & Women	Total	Employees	68,700.0	tughrits	month	192	357.813	2002	430
Portugal	Men & Women	Total	Wage Earners	3.58	PSE	hour	1	3.581	1999	10,720
Rwanda	Men & Women	Total	Employees	27,659.0	Francs	month	192	144.057	1997	230
Saudi Arabia	Men & Women	Total	Employees	657.0	Riyals	week	44	14.932	1997	8,530
Serbia and Montenegro	Men & Women	Total	Employees	7,866.0	New Dinars	month	192	40.969	2002	1,400
Seychelles	Men & Women	Total	Employees	3,300.0	Rupees	month	192	17.188	2002	6,910
Slovakia	Men & Women	Total	Employees	13,837.0	korung	month	192	72.068	2002	4,050
Uruguay	Men & Women	Total	Employees	6,856.7	Pesos	month	192	35.712	2001	4,350
Venezuela	Men & Women	Total	Employees	141,122.0	bolivars	month	192	735.010	1997	4,090
West Bank & Gaza	Men & Women	Total	Employees	70.1	N. Shekels	day	8	8.763	2002	1,110

Sources: Wage rate data from June 30, 2005 extraction of data from ILO website. CPI, per-capita GNI, and exchange rates from Commerce extraction of data from the IMF and World Bank
See http://ia.ita.doc.gov/wages/03wages/03wages.html

Wage Rate and Per Capita GNI Data for Excluded Countries -- 2003 Base Year

From Extraction of Data from ILO Website on June 30, 2005 (See Attachment 2)										Calculations					
Country	Reported Wage Rate	Data Year	Measuring Currency	Measuring Unit	Hours per Measuring Unit	Worker coverage	Sex	Sub-Classification (Industry)	Code Table	Home Currency/ hour	Inflator	Home Currency/ hour (inflated)	Exchange Rate, $/fc	Wage Rate, $/hr.	Per Capita GNI
Albania	14,334.0	2003	Leks	month	192	Employees	Men and Women	Total	5B	74.66	1.00	75.02	0.0082	0.617	1,740
Bahrain*	228.0	2002	Dinars	month	192	Employees	Men and Women	Total	5B	1.19	n/a	n/a	2.6596	n/a	10,850
Cambodia	243,000.0	2001	Riels	month	192	Employees	Men and Women	Total	5B	1265.63	1.04	1322.26	0.0003	0.333	300
Czech Republic	15,832.0	2003	Koruny	month	192	Employees	Men and Women	Total	5B	82.46	1.00	82.46	0.0355	2.928	7,150
Denmark	207.0	2002	Kroner	hour	1	Employees	Men and Women	Total	5B	207.02	1.02	211.08	0.1521	32.102	33,570
Fiji	15.2	1999	Dollars	day	8	Wage earners	Men and Women	Total	5B	1.89	1.11	2.10	0.5286	1.108	2,240
Gambia*	969.7	1998	Dalasis	month	192	Employees	Men and Women	Total	5B	5.05	n/a	n/a	0.0368	n/a	270
Hong Kong, China	326.1	2002	Dollars	day	8	Wage earners	Men and Women	Total	5B	40.76	0.97	39.71	0.1284	5.099	25,860
Hungary	124,076.0	2003	Forint	month	192	Employees	Men and Women	Total	5B	646.23	1.00	646.23	0.0045	2.883	6,350
Iceland	1,173.0	2003	Kronur	hour	1	Employees	Men and Women	Total	5B	1173.00	1.00	1173.00	0.0130	15.305	30,910
Indonesia	129.2	2001	Rupiahs (1,000)	week	44	Wage earners	Men and Women	Total	5B	2936.36	1.19	3501.52	0.0001	0.408	810
Iran, Islamic Rep. of	1,014,285	2001	Rials	month	192	Employees	Men and Women	Total	5B	5282.73	1.33	7034.75	0.0001	0.859	2,010
Kazakhstan	24,823.0	2003	Tenges	month	192	Employees	Men and Women	Total	5B	129.29	1.00	129.29	0.0067	0.865	1,780
Kuwait	1.4	2000	Dinars	hour	1	Employees	Men and Women	Total	5B	1.36	1.04	1.41	3.3557	4.733	17,960
Latvia	159.3	2003	Lats	month	192	Employees	Men and Women	Total	5B	0.83	1.00	0.83	1.7507	1.452	4,400
Lithuania	6.6	2003	Litas	hour	1	Employees	Men and Women	Total	5B	6.60	1.00	6.60	0.3273	2.160	4,500
Luxembourg	13.5	2003	Euros	hour	1	Wage earners	Men and Women	Total	5B	13.49	1.00	13.49	1.1308	15.255	45,740
Macedonia	10,028.0	2003	Denars	month	192	Employees	Men and Women	Total	5B	52.23	1.00	52.23	0.0184	0.963	1,980
Malta	2.3	2003	Pounds	hour	1	Total employment	Men and Women	Total	5B	2.30	1.00	2.30	2.6544	6.105	10,780
Mongolia	82.7	2003	Tughriks (1,000)	month	192	Employees	Men and Women	Total	5B	430.73	1.00	430.73	0.0009	0.376	480
Portugal**	718.0	1999	PTE	hour	1	Wage earners	Men and Women	Total	5B	718.00	1.15	825.06	0.0056	4.642	11,800
Serbia and Montenegro***	8,991.0	2003	New Dinars	month	192	Employees	Men and Women	Total	5B	46.83	1.00	46.83	0.0173	0.812	1,910
Seychelles	3,300.0	2002	Rupees	month	192	Employees	Men and Women	Total	5B	17.19	1.03	17.76	0.1854	3.292	7,490
Slovakia	14,873.0	2003	Koruny	month	192	Employees	Men and Women	Total	5B	77.46	1.00	77.46	0.0273	2.111	4,940
Uruguay	6,856.0	2001	Pesos	month	192	Employees	Men and Women	Total	5B	35.71	1.36	48.58	0.0355	1.724	3,820
West Bank & Gaza*	70.1	2002	New Shekels	day	8	Employees	Men and Women	Total	5B	8.76	n/a	n/a	0.2199	n/a	1,110

* Excluded from analysis because no CPI data available for 2003 from IFS of IMF

** According to ILO, 1 Euro = 200.482 PTE for wages reported prior to 2000.

*** Exchange rate data from www.oanda.com, since not included on Commerce exchange rate file.

Attachment 12

Wage and Per-Capita GNI, All Countries for Which Data are Available, 1999

Country	$/hr	Per Capita	World Bank
Albania	0.406	980	LMI
Algeria	1.100	1,550	LMI
Argentina	4.160	7,550	UMI
Australia	11.510	20,950	HI
Austria	11.530	25,430	HI
Bahrain	1.923	9,580	UMI
Bangladesh	0.191	370	LI
Belgium	10.960	24,650	HI
Bolivia	1.130	990	LMI
Botswana	0.760	3,240	UMI
Brazil	1.980	4,350	UMI
Bulgaria	0.580	1,410	LMI
Cambodia	0.346	270	LI
Canada	11.580	20,140	HI
Chile	2.080	4,630	UMI
Colombia	1.270	2,170	LMI
Costa Rica	1.780	3,570	UMI
Croatia	2.830	4,530	UMI
Cyprus	5.833	12,220	HI
Czech Republic	1.553	5,500	UMI
Denmark	26.171	32,240	HI
Dominican Republic	1.500	1,920	LMI
Ecuador	0.770	1,360	LMI
Egypt	0.740	1,380	LMI
El Salvador	1.490	1,920	LMI
Fiji	0.962	2,430	LMI
Finland	11.370	24,730	HI
France	9.100	24,170	HI
Gambia	0.453	330	LI
Germany	15.640	25,620	HI
Greece	5.170	12,110	HI
Guatemala	1.130	1,680	LMI
Hong Kong, China	5.393	25,580	HI
Hungary	1.674	4,490	UMI
Iceland	11.949	28,580	HI
India	0.160	440	LI
Indonesia	0.220	590	LI
Iran	2.075	1,600	LMI
Ireland	7.780	21,470	HI
Israel	10.150	16,310	HI
Italy	12.762	20,350	HI
Japan	13.310	32,030	HI
Jordan	1.040	1,630	LMI
Kenya	0.440	360	LI
Korea, Republic of	6.460	8,490	HI
Kuwait	4.044	15,280	HI
Latvia	1.148	2,810	LMI
Luxembourg	11.455	44,830	HI
Macau, China	1.904	14,420	HI
Malawi	0.065	190	LI
Malaysia	1.750	3,390	UMI
Mauritius	0.820	390	UMI
Mexico	1.300	4,440	UMI
Netherlands	15.930	25,140	HI
New Zealand	8.950	13,990	HI
Nicaragua	1.020	410	LI
Norway	14.990	33,470	HI
Pakistan	0.380	470	LI
Panama	1.310	3,080	UMI
Paraguay	1.270	1,560	LMI
Peru	0.940	2,130	LMI
Philippines	1.200	1,050	LMI
Poland	1.610	4,070	UMI
Portugal	3.357	11,000	HI
Rwanda	0.442	270	LI
St. Vincent and Grenadines	1.192	2,700	LMI
Saudi Arabia	3.914	7,810	UMI
Serbia and Montenegro	0.502	1,030	LMI
Seychelles	2.888	7,290	UMI
Singapore	8.610	24,150	HI
Slovakia	1.337	3,900	UMI
Slovenia	4.130	10,000	HI
Solomon Islands	1.368	870	LI
South Africa	4.000	3,170	UMI
Spain	9.840	14,800	HI
Sri Lanka	0.310	820	LMI
Sweden	13.050	26,750	HI
Switzerland	19.980	38,380	HI
Thailand	0.820	2,010	LMI
Tonga	1.094	1,730	LMI
Trinidad and Tobago	3.390	4,750	UMI
Turkey	1.490	2,900	UMI
United Kingdom	15.360	23,590	HI
United States	13.910	31,910	HI
Uruguay	3.027	6,320	UMI
Venezuela	2.040	3,700	UMI
Zimbabwe	0.840	530	LI

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (56)	LI and LMI (20)	1,290
	UMI and HI (36)	15,343
	All (56)	10,324
Excluded Countries (31)	LI and LMI (14)	1,155
	UMI and HI (17)	14,888
	All (31)	8,686
All Countries (87)	LI and LMI (34)	1,234
	UMI and HI (53)	15,197
	All (87)	9,740

Sources:

Countries in Bold, supporting wage rate calculations in Attachment 11.
Other countries, data files contained on Commerce website.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2000

Country	$/hr	Per Capita	World Bank
Albania	0.425	1,160	LMI
Algeria	0.970	1,580	LMI
Argentina	4.230	7,460	UMI
Australia	10.710	20,240	HI
Austria	9.320	25,220	HI
Bahrain	3.200	10,420	UMI
Bangladesh	0.184	380	LI
Belgium	9.880	24,540	HI
Bolivia	1.110	990	LMI
Botswana	0.760	3,300	UMI
Brazil	2.560	3,580	UMI
Bulgaria	0.560	1,520	LMI
Cambodia	0.340	280	LI
Canada	11.860	21,130	HI
Chile	2.030	4,590	UMI
Colombia	1.050	2,020	LMI
Costa Rica	1.840	3,810	UMI
Croatia	2.580	4,620	UMI
Cyprus	5.196	12,460	HI
Czech Republic	1.491	5,690	UMI
Denmark	23.401	31,450	HI
Dominican Republic	1.580	2,130	LMI
Ecuador	0.710	1,210	LMI
Egypt	0.740	1,490	LMI
El Salvador	1.150	2,000	LMI
Fiji	0.901	2,220	LMI
Finland	10.190	25,130	HI
France	8.010	24,090	HI
Gambia	0.406	320	LI
Germany	13.100	25,120	HI
Greece	4.460	11,960	HI
Guatemala	1.110	1,680	LMI
Hong Kong, China	5.381	26,830	HI
Hungary	1.641	4,620	UMI
Iceland	12.071	29,980	HI
India	0.160	450	LI
Indonesia	0.267	570	LI
Iran	2.563	1,650	LMI
Ireland	6.570	22,660	HI
Israel	10.780	16,710	HI
Italy	16.629	20,160	HI
Japan	14.170	35,620	HI
Jordan	1.050	1,710	LMI
Kenya	0.440	350	LI
Korea, Republic of	7.380	8,910	HI
Kuwait	4.417	16,280	HI
Latvia	1.162	3,200	LMI
Luxembourg	13.583	43,540	HI
Malawi	0.065	170	LI
Malaysia	1.902	3,390	UMI
Malta	4.799	9,570	HI
Mauritius	0.830	3,750	UMI
Mexico	2.060	5,070	UMI
Mongolia	0.320	400	LI
Netherlands	14.280	24,970	HI
New Zealand	7.880	12,990	HI
Nicaragua	1.060	400	LI
Norway	15.040	34,530	HI
Pakistan	0.290	440	LI
Panama	1.330	3,260	UMI
Paraguay	1.210	1,440	LMI
Peru	0.980	2,080	LMI
Philippines	1.050	1,040	LMI
Poland	2.190	4,190	UMI
Portugal	3.990	10,930	HI
Rwanda	0.398	260	LI
St. Vincent and Grenadines	1.192	2,800	LMI
Saudi Arabia	3.870	8,120	UMI
Seychelles	2.801	7,310	UMI
Singapore	9.190	24,740	HI
Slovakia	1.331	3,860	UMI
Slovenia	3.740	10,050	HI
Solomon Islands	1.419	710	LI
South Africa	3.710	3,020	UMI
Spain	7.350	15,080	HI
Sri Lanka	0.300	850	LMI
Sweden	12.150	27,140	HI
Switzerland	18.030	38,140	HI
Thailand	0.780	2,000	LMI
Trinidad and Tobago	3.510	4,930	UMI
Turkey	1.550	3,100	UMI
United Kingdom	14.730	24,430	HI
United States	14.380	34,100	HI
Uruguay	2.952	6,120	UMI
Venezuela	2.108	4,290	UMI
Zimbabwe	0.860	460	LI

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (56)	LI and LMI (20)	1,292
	UMI and HI (36)	15,710
	All (56)	10,561
Excluded Countries (30)	LI and LMI (13)	1,086
	UMI and HI (17)	14,802
	All (30)	8,858
All Countries (86)	LI and LMI (33)	1,211
	UMI and HI (53)	15,419
	All (86)	9,967

Sources:

Countries in Bold, supporting wage rate calculations in Attachment 11.
Other countries, data files contained on Commerce website.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2001

Country	$/hr.	Per Capita	World Bank
Albania	0.510	1,340	LMI
Algeria	0.99	1,650	LMI
Argentina	4.29	6,940	UMI
Australia	10.00	19,900	HI
Austria	9.27	23,940	HI
Bahrain	2.978	10,590	HI
Bangladesh	0.175	380	LI
Belgium	9.82	23,850	HI
Bolivia	0.9	950	LMI
Botswana	0.74	3,100	UMI
Brazil	1.87	3,070	LMI
Bulgaria	0.56	1,650	LMI
Cambodia	0.323	280	LI
Canada	11.99	21,930	HI
Chile	1.75	4,590	UMI
Colombia	1.03	1,890	LMI
Costa Rica	2.03	4,060	UMI
Croatia	2.79	4,550	UMI
Cyprus	5.788	12,320	HI
Czech Republic	1.936	5,650	UMI
Denmark	23.942	30,480	HI
Dominican Republic	1.67	2,230	LMI
Ecuador	1.86	1,080	LMI
Egypt	0.64	1,530	LMI
El Salvador	1.2	2,040	LMI
Fiji	0.877	2,090	LMI
Finland	10.37	23,780	HI
France	7.54	22,730	HI
Gambia	0.357	310	LI
Germany	12.88	23,560	HI
Greece	4.41	11,430	HI
Guatemala	1.18	1,680	LMI
Guinea	0.712	420	LI
Hong Kong, China	5.491	25,790	HI
Hungary	1.850	4,620	UMI
Iceland	10.830	28,430	HI
India	0.15	460	LI
Indonesia	0.288	680	LMI
Iran	3.010	1,680	LMI
Ireland	9.16	22,850	HI
Israel	11.2	16,750	HI
Japan	12.75	35,610	HI
Jordan	1.00	1,750	LMI
Kenya	0.48	350	LI
Korea	6.87	9,460	HI
Kuwait	4.492	16,760	HI
Latvia	1.164	3,520	UMI
Luxembourg	14.097	43,150	HI
Malaysia	2.1	3,330	UMI
Malta	4.890	9,690	HI
Mauritius	0.79	3,830	UMI
Mexico	2.49	5,530	UMI
Mongolia	0.333	410	LI
Netherlands	14.57	24,330	HI
New Zealand	7.36	13,250	HI
Nicaragua	1.27	457	LI
Norway	14.15	35,630	HI
Pakistan	0.26	420	LI
Panama	1.33	3,260	UMI
Paraguay	1.1	1,350	LMI
Peru	0.97	1,980	LMI
Philippines	0.79	1,030	LMI
Poland	2.45	4,230	UMI
Portugal	4.295	10,620	HI
Rwanda	0.362	240	LI
St. Vincent and Grenadines	1.228	2,940	UMI
Saudi Arabia	3.827	8,420	HI
Seychelles	2.887	7,220	UMI
Singapore	9.07	21,500	HI
Slovakia	1.391	3,860	UMI
Slovenia	3.83	9,760	HI
Solomon Islands	1.425	610	LI
South Africa	2.68	2,820	UMI
Spain	9.34	14,300	HI
Sri Lanka	0.3	880	LMI
Sweden	11.12	25,400	HI
Switzerland	18.24	38,330	HI
Thailand	0.71	1,940	LMI
Trinidad and Tobago	3.74	5,960	UMI
Turkey	1.22	2,530	UMI
United Kingdom	15.11	25,120	HI
United States	14.83	34,280	HI
Uruguay	2.685	5,630	UMI
Venezuela	2.230	4,730	UMI
Zimbabwe	1.35	480	LI

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (56)	LI and LMI (21)	1,375
	UMI and HI (35)	15,783
	All (56)	10,380
Excluded Countries (30)	LI and LMI (11)	767
	UMI and HI (18)	13,023
	All (29)	8,374
All Countries (85)	LI and LMI (32)	1,166
	UMI and HI (53)	14,846
	All (85)	9,696

Sources:

Countries in Bold, supporting wage rate calculations in Attachment 11.
Other countries, data files contained on Commerce website for 2001 wage rate calculations.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2002

Country	$/hr	Per capita	World Bank Classification*
Albania	0.53	1,450	LMI
Argentina	1.92	4,220	UMI
Australia	11.12	19,530	HI
Austria	10.25	23,860	HI
Bahrain	3.16	11,260	HI
Belgium	11.10	22,940	HI
Bolivia	0.83	910	LMI
Botswana	0.73	2,990	UMI
Brazil	1.66	2,830	LMI
Bulgaria	0.61	1,790	LMI
Cambodia	0.33	300	LI
Canada	12.17	22,390	HI
Chile	1.66	4,350	UMI
Colombia	0.73	1,810	LMI
Costa Rica	2.04	4,070	UMI
Croatia	3.18	4,620	UMI
Czech Republic	1.97	5,480	UMI
Denmark	26.31	30,260	HI
Dominican Republic	1.61	2,310	LMI
Ecuador	1.43	1,490	LMI
Egypt	0.74	1,470	LMI
El Salvador	1.21	2,080	LMI
Fiji	0.92	2,080	LMI
Finland	11.59	23,890	HI
France	7.69	22,240	HI
Gambia	0.30	270	LI
Germany	13.90	22,740	HI
Greece	4.80	11,660	HI
Guatemala	1.22	1,750	LMI
Hong Kong	7.98	24,690	HI
Hungary	2.32	5,290	UMI
Iceland	10.10	27,960	HI
India	0.21	470	LI
Indonesia	0.35	710	LMI
Iran	1.21	1,720	LMI
Ireland	11.61	23,030	HI
Israel	10.10	16,020	HI
Japan	12.33	34,010	HI
Jordan	1.38	1,760	LMI
Kazakstan*	0.57	1,520	LMI
Kenya	0.49	360	LI
Korea	7.74	11,280	HI
Kuwait	4.60	16,340	HI
Latvia	1.23	3,480	UMI
Luxembourg	12.37	39,470	HI
Macedonia	0.81	1,710	LMI
Malaysia	2.14	3,550	UMI
Malta	5.31	9,260	HI
Mauritius	1.07	3,860	UMI
Mexico	2.60	5,940	UMI
Mongolia	0.32	430	LI
Netherlands	15.83	23,390	HI
New Zealand	8.36	13,250	HI
Nicaragua	0.94	720	LI
Norway	17.07	38,730	HI
Pakistan	0.36	420	LI
Panama	1.80	4,020	UMI
Paraguay	0.69	1,180	LMI
Peru	1.00	2,020	LMI
Philippines	0.81	1,030	LMI
Poland	2.44	4,670	UMI
Portugal	3.98	10,720	HI
Rwanda	0.35	230	LI
Saudi Arabia	3.84	8,530	HI
Serbia and Montenegro	0.63	1,400	LMI
Seychelles	3.14	6,910	UMI
Singapore	9.18	21,180	HI
Slovakia	1.59	3,970	UMI
Slovenia	4.26	10,200	HI
South Africa	2.58	2,630	UMI
Spain	10.36	14,580	HI
Sri Lanka	0.33	850	LMI
Sweden	12.18	25,970	HI
Switzerland	20.64	36,170	HI
Thailand	0.74	2,000	LMI
Trinidad and Tobago	4.23	6,600	UMI
Turkey	2.82	2,510	UMI
United Kingdom	16.54	25,490	HI
United States	15.30	35,400	HI
Uruguay	2.06	4,340	UMI
Venezuela	1.79	4,080	UMI
West Bank & Gaza	1.85	1,110	LMI

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (54)	LI and LMI (19)	1,434
	UMI and HI (35)	15,771
	All (54)	10,726
Excluded Countries (28)	LI and LMI (12)	1,078
	UMI and HI (16)	13,253
	All (28)	7,773
All Countries (82)	LI and LMI (31)	1,472
	UMI and HI (51)	14,981
	All (82)	9,807

Sources:

Countries in Bold, supporting wage rate calculations in Attachment 11.
Other Countries, Commerce July 7, 2005 Draft Results, at Exh. III
World Bank country classification, see attached.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2003

Country	$/hr	Per Capita	World Bank Classification
Albania	0.62	1,740	LMI
Argentina	2.12	3,810	UMI
Australia	13.70	21,950	HI
Austria	12.44	26,810	HI
Belgium	13.50	25,760	HI
Bolivia	0.81	900	LMI
Botswana	1.00	3,530	UMI
Brazil	1.76	2,720	LMI
Bulgaria	0.75	2,130	LMI
Cambodia	0.33	300	LI
Canada	14.10	24,470	HI
Chile	1.70	4,360	UMI
Colombia	0.80	1,810	LMI
Costa Rica	2.00	4,300	UMI
Croatia	3.92	5,370	UMI
Czech Republic	2.93	7,150	UMI
Denmark	32.10	33,570	HI
Ecuador	1.54	1,830	LMI
Egypt	0.60	1,390	LMI
El Salvador	1.25	2,340	LMI
Fiji	1.11	2,240	LMI
Finland	14.00	27,060	HI
France	9.40	24,730	HI
Germany	17.06	25,270	HI
Greece	5.92	13,230	HI
Guatemala	1.27	1,910	LMI
Hong Kong	5.10	25,860	HI
Hungary	2.88	6,350	UMI
Iceland	15.31	30,910	HI
India	0.23	540	LI
Indonesia	0.41	810	LMI
Iran	0.86	2,010	LMI
Ireland	14.66	27,010	HI
Israel	10.56	16,240	HI
Japan	13.34	34,180	HI
Jordan	1.41	1,850	LMI
Kazakhstan	0.87	1,780	LMI
Korea, Republic	9.07	12,030	HI
Kuwait	4.73	17,960	HI
Latvia	1.45	4,400	UMI
Lithuania	2.16	4,500	UMI
Luxembourg	15.26	45,740	HI
Macedonia	0.96	1,980	LMI
Malaysia	2.16	3,880	UMI
Malta	6.11	10,780	HI
Mauritius	1.25	4,100	UMI
Mexico	2.49	6,230	UMI
Mongolia	0.38	480	LI
Netherlands	19.71	26,230	HI
New Zealand	10.96	15,530	HI
Nicaragua	0.94	740	LI
Norway	19.73	43,400	HI
Pakistan	0.38	520	LI
Panama	1.70	4,060	UMI
Paraguay	0.66	1,110	LMI
Peru	0.98	2,140	LMI
Philippines	0.80	1,080	LMI
Poland	2.73	5,280	UMI
Portugal	4.64	11,800	HI
Serbia and Montenegro	0.81	1,910	LMI
Seychelles	3.29	7,490	UMI
Singapore	9.76	21,230	HI
Slovakia	2.11	4,940	UMI
Slovenia	5.31	11,920	HI
South Africa	3.82	2,750	UMI
Spain	13.00	17,040	HI
Sri Lanka	0.34	930	LMI
Sweden	15.12	28,910	HI
Switzerland	23.98	40,680	HI
Thailand	0.78	2,190	LMI
Trinidad and Tobago	4.35	7,790	UMI
Turkey	3.56	2,800	UMI
United Kingdom	18.68	28,320	HI
United States	15.65	37,870	HI
Uruguay	1.72	3,820	UMI
Average	6.05	11,504	
DOC Included Countries	6.69	12,197	
DOC Excluded Countries	4.61	9,936	

* World Bank classifications of country income categories:

LI = Low Income
LMI = Lower Middle Income
UMI = Upper Middle Income
HI = High Income

		Per capita GNI
DOC Countries (52)	LI and LMI (17)	1,537
	UMI and HI (35)	17,375
	All (52)	12,197
Excluded Countries (23)	LI and LMI (9)	1,472
	UMI and HI (14)	15,376
	All (23)	9,936
All Countries (75)	LI and LMI (26)	1,515
	UMI and HI (49)	16,804
	All (75)	11,504

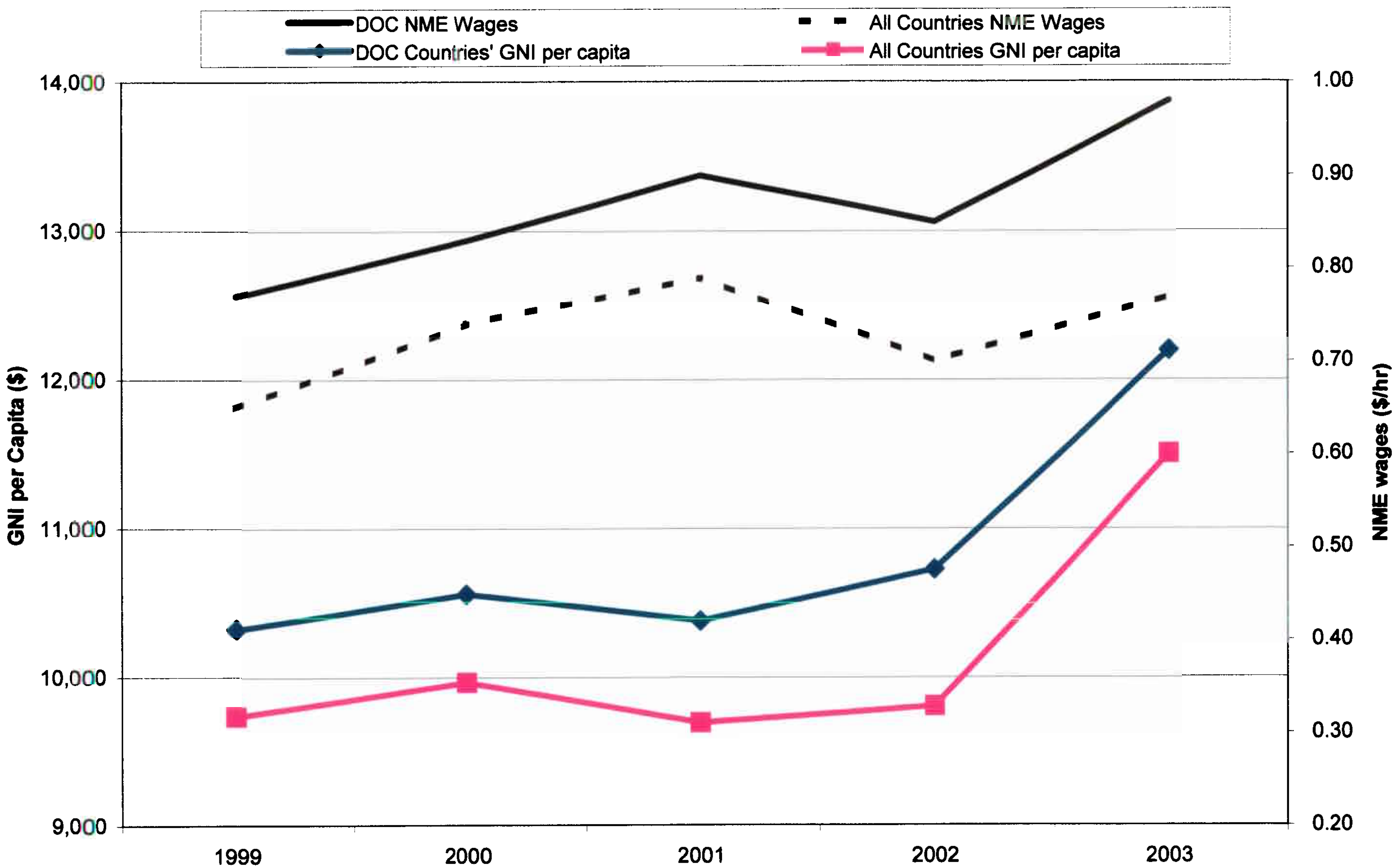
Sources:

Countries in Bold, supporting wage rate calculations in Attachment 4.
Other countries, data files contained on Commerce website supporting 2003 sample calculations.

Cyprus, Macao (No firm 2003 GNI data from World Bank)
Bahrain, Gambia, West Bank/Gaza (No CPI data for 2003 from IFS)
Estonia, Russia, Romania (ILO wage prior to market economy status)

Attachment 13

Per Capita GNI of Countries Included and Excluded By DOC NME Wage Analysis



Sources: Per-capita GNI at Attachment 10. Estimated wages for all countries, see attached sheets. Wages for DOC subset of countries, DOC website, except for 2002, see DOC July 7, 2005 memo.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 1999

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9116
R Square	0.8309
Adjusted R Square	0.8290
Standard Error	2.2678
Observations	87

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2148.721	2148.721	417.8028	1.4658E-34
Residual	85	437.1472	5.142908		
Total	86	2585.868			

	Coefficients	*andard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.3014	0.3245	0.9287	0.3557	-0.3438	0.9465	-0.3438	0.9465
X Variable 1	0.000451	0.0000	20.4402	0.0000	0.0004	0.0005	0.0004	0.0005

China GNI	780
Wage	0.65

Estimated based on data contained in Attachment 12.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2000

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9217
R Square	0.8496
Adjusted R Square	0.8478
Standard Error	2.0423
Observations	86

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	1979.46	1979.46	474.58	0.00
Residual	84	350.36	4.17		
Total	85	2329.81			

	Coefficients	*andard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.3787	0.2949	1.2843	0.2026	-0.2077	0.9651	-0.2077	0.9651
X Variable 1	0.000429	0.0000	21.7849	0.0000	0.0004	0.0005	0.0004	0.0005

China GNI	840
China Wage	0.74

Estimated based on data contained in Attachment 12.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2001

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9290
R Square	0.8631
Adjusted R Square	0.8614
Standard Error	1.8936
Observations	85

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	1875.934	1875.934	523.1929	1.37E-37
Residual	83	297.6006	3.58555		
Total	84	2173.535			

	Coefficients	*andard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.4081	0.2739	1.4902	0.1400	-0.1366	0.9528	-0.1366	0.9528
X Variable 1	0.000427	0.00002	22.87341	0.00000	0.00039	0.00046	0.00039	0.00046

China GNI	890
China Wage	0.79

Estimated based on data contained in Attachment 12.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2002

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9263
R Square	0.8580
Adjusted R Square	0.8562
Standard Error	2.1240
Observations	82

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	2180.694	2180.694	483.3828	1.18E-35
Residual	80	360.9055	4.511319		
Total	81	2541.6			

	Coefficients	*andard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.2459	0.3154	0.7799	0.4378	-0.3817	0.8736	-0.3817	0.8736
X Variable 1	0.000473	0.0000	21.9860	0.0000	0.0004	0.0005	0.0004	0.0005

GNI	960
China Wage	0.70

Estimated based on data contained in Attachment 12.

Wage and Per-Capita GNI, All Countries for Which Data are Available, 2003

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.914
R Square	0.836
Adjusted R Square	0.833
Standard Error	2.819
Observations	75

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2946.7	2946.7	370.8	0.0
Residual	73	580.1	7.9		
Total	74	3526.8			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0.2101	0.4449	0.4723	0.6381	-0.6766	1.0969	-0.6766	1.0969
X Variable 1	0.000508	0.0000	19.2571	0.0000	0.0005	0.0006	0.0005	0.0006

China GNI	1100		
Wage	0.7687	Formula	Intercept + GNI-Coefficient * 1,100
Wage	0.7687	Alternative Formula	Average wage - (Avg. GNI - China GNI) * GNI Coefficient 6.05 - (11,504 - 1,100) * .000508

Estimated based on data contained in Attachment 12.

Attachment 14

CHAPTER 11

HETEROSCEDASTICITY

> Heteroscedasticity has never been a reason to throw out an otherwise good model.*
>
> But it should not be ignored either!
>
> Author

An important assumption of the classical linear regression model (Assumption 4) is that the disturbances u_i appearing in the population regression function are homoscedastic; that is, they all have the same variance. In this chapter we examine the validity of this assumption and find out what happens if this assumption is not fulfilled. As in Chapter 10, we seek answers to the following questions:

1. What is the nature of heteroscedasticity?
2. What are its consequences?
3. How does one detect it?
4. What are the remedial measures?

11.1 THE NATURE OF HETEROSCEDASTICITY

As noted in Chapter 3, one of the important assumptions of the classical linear regression model is that the variance of each disturbance term u_i, conditional on the chosen values of the explanatory variables, is some constant number

*N. Gregory Mankiw, "A Quick Refresher Course in Macroeconomics," *Journal of Economic Literature*, vol. XXVIII, December 1990, p. 1648.

equal to σ^2. This is the assumption of **homoscedasticity**, or *equal* (homo) *spread* (scedasticity), that is, *equal variance*. Symbolically,

$$E(u_i^2) = \sigma^2 \qquad i = 1, 2, \ldots, n \tag{11.1.1}$$

Diagrammatically, in the two-variable regression model homoscedasticity can be shown as in Fig. 3.4, which, for convenience, is reproduced as Fig. 11.1. As Fig. 11.1 shows, the conditional variance of Y_i (which is equal to that of u_i), conditional upon the given X_i, remains the same regardless of the values taken by the variable X.

In contrast, consider Fig. 11.2, which shows that the conditional variance of Y_i increases as X increases. Here, the variances of Y_i are not the same. Hence, there is heteroscedasticity. Symbolically,

$$E(u_i^2) = \sigma_i^2 \tag{11.1.2}$$

Notice the subscript of σ^2, which reminds us that the conditional variances of u_i (= conditional variances of Y_i) are no longer constant.

To make the difference between homoscedasticity and heteroscedasticity clear, assume that in the two-variable model $Y_i = \beta_1 + \beta_2 X_i + u_i$, Y represents savings and X represents income. Figures 11.1 and 11.2 show that as income increases, savings on the average also increase. But in Fig. 11.1 the variance of savings remains the same at all levels of income, whereas in Fig. 11.2 it increases with income. It seems that in Fig. 11.2 the higher-income families on the average save more than the lower-income families, but there is also more variability in their savings.

There are several reasons why the variances of u_i may be variable, some of which are as follows.[1]

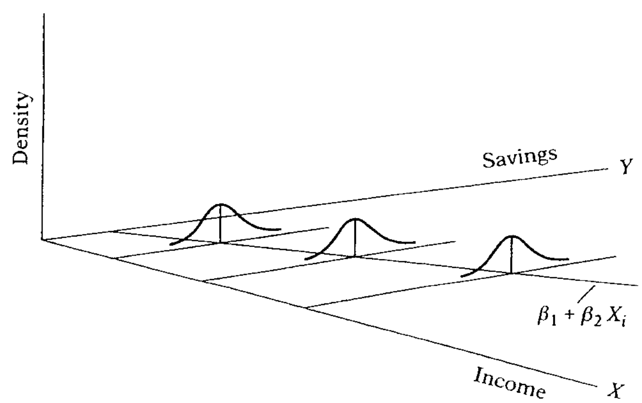


FIGURE 11.1
Homoscedastic disturbances.

[1] See Stefan Valavanis, *Econometrics*, McGraw-Hill, New York, 1959, p. 48.

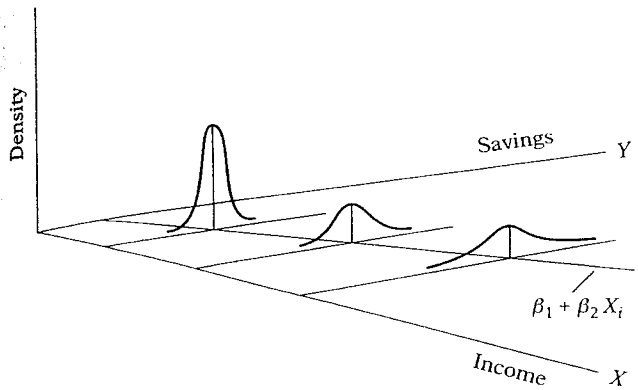


FIGURE 11.2
Heteroscedastic disturbances.

1. Following the *error-learning models*, as people learn, their errors of behavior become smaller over time. In this case, σ_i^2 is expected to decrease. As an example, consider Fig. 11.3, which relates the number of typing errors made in a given time period on a test to the hours put in typing practice. As Fig. 11.3 shows, as the number of hours of typing practice increases, the average number of typing errors as well as their variances decreases.
2. As incomes grow, people have more *discretionary income*[2] and hence more scope for choice about the disposition of their income. Hence, σ_i^2 is likely to increase with income. Thus in the regression of savings on income one is likely to find σ_i^2 increasing with income (as in Fig. 11.2) because people have more choices about their savings behavior. Similarly, companies with larger

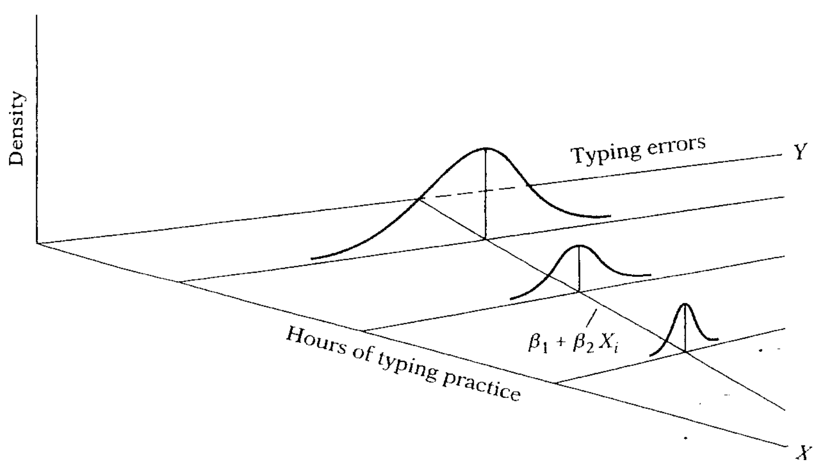


FIGURE 11.3
Illustration of heteroscedasticity.

[2]As Valavanis puts it, "Income grows, and people now barely discern dollars whereas previously they discerned dimes," ibid., p. 48.

profits are generally expected to show greater variability in their dividend policies than companies with lower profits. Also, *growth-oriented* companies are likely to show more variability in their dividend payout ratio than established companies.

3. As data collecting techniques improve, σ_i^2 is likely to decrease. Thus, banks that have sophisticated data processing equipment are likely to commit fewer errors in the monthly or quarterly statements of their customers than banks without such facilities.
4. Heteroscedasticity can also arise as a result of the presence of **outliers**. An outlying observation, or outlier, is an observation that is much different (either very small or very large) in relation to the other observations in the sample. The inclusion or exclusion of such an observation, especially if the sample size is small, can substantially alter the results of regression analysis. As an example, consider the scattergram given in Fig. 11.4. Based on the data given in exercise 11.20, this figure plots percent rate of change of stock prices (Y) and consumer prices (X) for the post–World War II period through 1969 for 20 countries. In this figure the observation on Y and X for Chile can be regarded as an outlier because the given Y and X values are much larger than for the rest of the countries. In situations such as this, it would be hard to maintain the assumption of homoscedasticity. In exercise 11.20 you are asked to find out what happens to the regression results if the observations for Chile are dropped from the analysis.

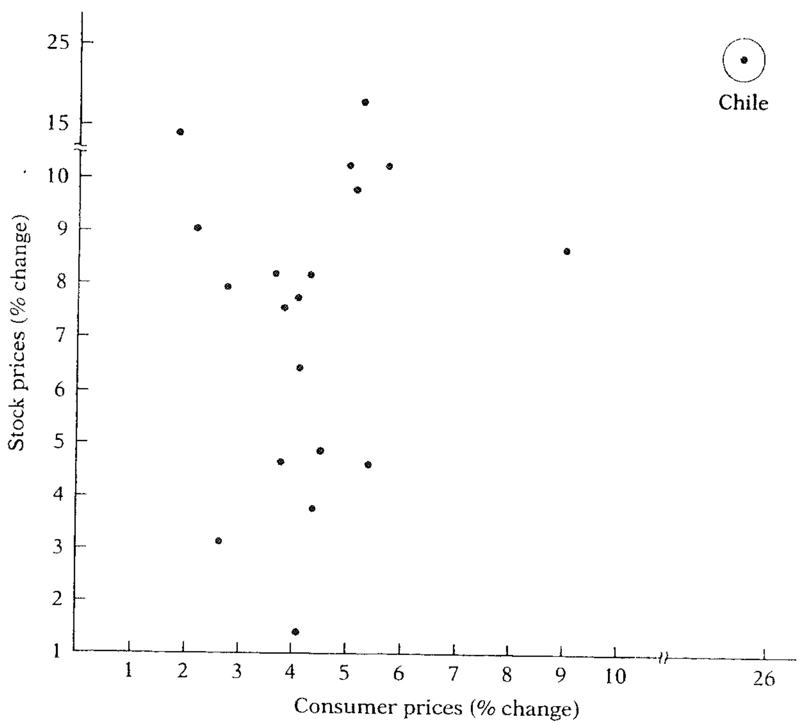


FIGURE 11.4
The relationship between stock prices and consumer prices.

5. Another source of heteroscedasticity arises from violating Assumption 9 of CLRM, namely, that the regression model is correctly specified. Although we will discuss the topic of specification errors more fully in Chapter 13, very often what looks like heteroscedasticity may be due to the fact that some important variables are omitted from the model. Thus, in the demand function for a commodity, if we do not include the prices of commodities complementary to or competing with the commodity in question (the omitted variable bias), the residuals obtained from the regression may give the distinct impression that the error variance may not be constant. But if the omitted variables are included in the model, that impression may disappear.

Note that the problem of heteroscedasticity is likely to be more common in cross-sectional than in time series data. In cross-sectional data, one usually deals with members of a population at a given point in time, such as individual consumers or their families, firms, industries, or geographical subdivisions such as state, country, city, etc. Moreover, these members may be of different sizes, such as small, medium, or large firms or low, medium, or high income. In time series data, on the other hand, the variables tend to be of similar orders of magnitude because one generally collects the data for the same entity over a period of time. Examples are GNP, consumption expenditure, savings, or employment in the United States, say, for the period 1950 to 1994.

As an illustration of heteroscedasticity likely to be encountered in cross-sectional analysis, consider Table 11.1. This table gives data on compensation per employee in 10 nondurable goods manufacturing industries, classified by the employment size of the firm or the establishment for the year 1958. Also given in the table are average productivity figures for nine employment classes.

Although the industries differ in their output composition, Table 11.1 shows clearly that on the average large firms pay more than the small firms. As an example, firms employing one to four employees paid on the average about \$3396, whereas those employing 1000 to 2499 employees on the average paid about \$4843. But notice that there is considerable variability in earning among various employment classes as indicated by the estimated standard deviations of earnings. This can be seen also from the accompanying figure, which shows the range of earnings within each employment class. As Fig. 11.5 shows, the range (highest value − lowest value), a crude measure of variability, differs from class to class, indicating heteroscedasticity in earnings in the various employment classes.

11.2 OLS ESTIMATION IN THE PRESENCE OF HETEROSCEDASTICITY

What happens to OLS estimators and their variances if we introduce heteroscedasticity by letting $E(u_i^2) = \sigma_i^2$ but retain all other assumptions of the classical model? To answer this question, let us revert to the two-variable model:

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

TABLE 11.1

Compensation per employee ($) in nondurable manufacturing industries according to employment size of establishment, 1958

Industry	Employment size (average number of employees)								
	1–4	**5–9**	**10–19**	**20–49**	**50–99**	**100–249**	**250–499**	**500–999**	**1000–2499**
Food and kindred products	2,994	3,295	3,565	3,907	4,189	4,486	4,676	4,968	5,342
Tobacco products	1,721	2,057	3,336	3,320	2,980	2,848	3,072	2,969	3,822
Textile mill products	3,600	3,657	3,674	3,437	3,340	3,334	3,225	3,163	3,168
Apparel and related products	3,494	3,787	3,533	3,215	3,030	2,834	2,750	2,967	3,453
Paper and allied products	3,498	3,847	3,913	4,135	4,445	4,885	5,132	5,342	5,326
Printing and publishing	3,611	4,206	4,695	5,083	5,301	5,269	5,182	5,395	5,552
Chemicals and allied products	3,875	4,660	4,930	5,005	5,114	5,248	5,630	5,870	5,876
Petroleum and coal products	4,616	5,181	5,317	5,337	5,421	5,710	6,316	6,455	6,347
Rubber and plastic products	3,538	3,984	4,014	4,287	4,221	4,539	4,721	4,905	5,481
Leather and leather products	3,016	3,196	3,149	3,317	3,414	3,254	3,177	3,346	4,067
Average compensation	3,396	3,787	4,013	4,014	4,146	4,241	4,387	4,538	4,843
Standard deviation	743.7	851.4	727.8	805.06	929.9	1080.6	1243.2	1307.7	1112.5
Average productivity	9,355	8,584	7,962	8,275	8,389	9,418	9,795	10,281	11,750

Source: The Census of Manufacturers, U.S. Department of Commerce, 1958 (computed by author).

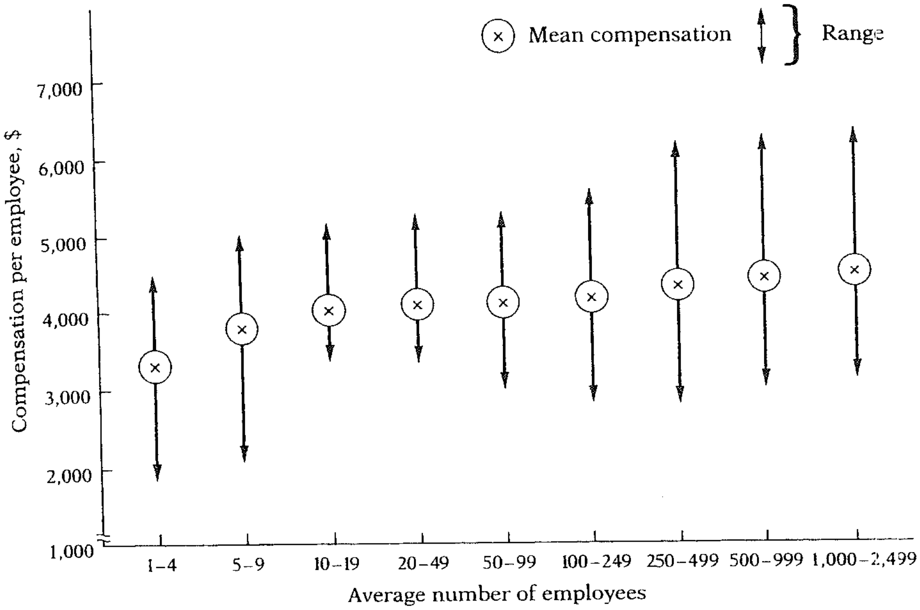


FIGURE 11.5
Per employee compensation in relation to employment size.

Applying the usual formula, the OLS estimator of β_2 is

$$\begin{aligned}\hat{\beta}_2 &= \frac{\sum x_i y_i}{\sum x_i^2} \\ &= \frac{n\sum X_i Y_i - \sum X_i \sum Y_i}{n\sum X_i^2 - (\sum X_i)^2}\end{aligned} \tag{11.2.1}$$

but its variance is now given by the following expression (see Appendix 11A, Section 11A.1):

$$\operatorname{var}(\hat{\beta}_2) = \frac{\sum x_i^2 \sigma_i^2}{(\sum x_i^2)^2} \tag{11.2.2}$$

which is obviously different from the usual variance formula obtained under the assumption of homoscedasticity, namely,

$$\operatorname{var}(\hat{\beta}_2) = \frac{\sigma^2}{\sum x_i^2} \tag{11.2.3}$$

Of course, if $\sigma_i^2 = \sigma^2$ for each i, the two formulas will be identical. (Why?)

Recall that $\hat{\beta}_2$ is best linear unbiased estimator (BLUE) if the assumptions of the classical model, including homoscedasticity, hold. Is it still BLUE when we drop only the homoscedasticity assumption and replace it with the assumption of heteroscedasticity? It is easy to prove that $\hat{\beta}_2$ is still linear and unbiased. As a matter of fact, as shown in Appendix 3A, Section 3A.2, to establish the unbiasedness of $\hat{\beta}_2$ it is not necessary that the disturbances (u_i) be homoscedastic. In fact, the variance of u_i, homoscedastic or heteroscedastic, plays no part in the determination of the unbiasedness property.

Granted that $\hat{\beta}_2$ is still linear unbiased, is it "efficient" or "best," that is, does it have minimum variance in the class of linear unbiased estimators? And is that minimum variance given by Eq. (11.2.2)? The answer is *no* to both the questions: $\hat{\beta}_2$ is no longer best and the minimum variance is not given by (11.2.2). Then what is BLUE in the presence of heteroscedasticity? The answer is given in the following section.

11.3 THE METHOD OF GENERALIZED LEAST SQUARES (GLS)

Why is the usual OLS estimator of β_2 given in (11.2.1) not best, although it is still unbiased? Intuitively, we can see the reason from Fig. 11.5. As this figure shows, there is considerable variability in the earnings between employment classes. If we were to regress per-employee compensation on the size of employment, we would like to make use of the knowledge that there is considerable interclass variability in earnings. Ideally, we would like to devise the estimating scheme in such a manner that observations coming from populations with greater variability are given less weight than those coming from populations with smaller variability. Examining Fig. 11.5, we would like to weight observations coming from employment classes 10–19 and 20–49 more heavily than those coming from employment classes like 5–9 and 250–499, for the former are more closely clustered around their mean values than the latter, thereby enabling us to estimate the PRF more accurately.

Unfortunately, the usual OLS method does not follow this strategy and therefore does not make use of the "information" contained in the unequal variability of the dependent variable Y, say, employee compensation of Fig. 11.5: It assigns equal weight or importance to each observation. But a method of estimation, known as **generalized least squares (GLS)**, takes such information into account explicitly and is therefore capable of producing estimators that are BLUE. To see how this is accomplished, let us continue with the now-familiar two-variable model:

$$Y_i = \beta_1 + \beta_2 X_i + u_i \tag{11.3.1}$$

which for ease of algebraic manipulation we write as

$$Y_i = \beta_1 X_{0i} + \beta_2 X_i + u_i \tag{11.3.2}$$

where $X_{0i} = 1$ for each i. The reader can see that these two formulations are identical.

Now assume that the heteroscedastic variances σ_i^2 are *known*. Divide (11.3.2) through by σ_i to obtain

$$\frac{Y_i}{\sigma_i} = \beta_1\left(\frac{X_{0i}}{\sigma_i}\right) + \beta_2\left(\frac{X_i}{\sigma_i}\right) + \left(\frac{u_i}{\sigma_i}\right) \tag{11.3.3}$$

which for ease of exposition we write as

$$Y_i^* = \beta_1^* X_{0i}^* + \beta_2 X_i^* + u_i^* \tag{11.3.4}$$

where the starred or transformed variables are the original variables divided by (the known) σ_i. We use the notation β_1^* and β_2^*, the parameters of the transformed model, to distinguish them from the usual OLS parameters β_1 and β_2.

What is the purpose of transforming the original model? To see this, notice the following feature of the transformed error term u_i^*:

$$\begin{aligned}
\text{var}(u_i^*) = E(u_i^*)^2 &= E\left(\frac{u_i}{\sigma_i}\right)^2 \\
&= \frac{1}{\sigma_i^2} E(u_i^2) \qquad \text{since } \sigma_i^2 \text{ is known} \\
&= \frac{1}{\sigma_i^2}(\sigma_i^2) \qquad \text{since } E(u_i^2) = \sigma_i^2 \\
&= 1
\end{aligned} \tag{11.3.5}$$

which is a constant. That is, the variance of the transformed disturbance term u_i^* is now homoscedastic. Since we are still retaining the other assumptions of the classical model, the finding that it is u^* that is homoscedastic suggests that if we apply OLS to the transformed model (11.3.3) it will produce estimators that are BLUE. In short, the estimated β_1^* and β_2^* are now BLUE and not the OLS estimators $\hat{\beta}_1$ and $\hat{\beta}_2$.

This procedure of transforming the original variables in such a way that the transformed variables satisfy the assumptions of the classical model and then applying OLS to them is known as the method of generalized least squares (GLS). *In short, GLS is OLS on the transformed variables that satisfy the standard least-squares assumptions.* The estimators thus obtained are known as **GLS estimators**, and it is these estimators that are BLUE.

The actual mechanics of estimating β_1^* and β_2^* are as follows. First, we write down the SRF of (11.3.3)

$$\frac{Y_i}{\sigma_i} = \hat{\beta}_1^*\left(\frac{X_{0i}}{\sigma_i}\right) + \hat{\beta}_2^*\left(\frac{X_i}{\sigma_i}\right) + \left(\frac{\hat{u}_i}{\sigma_i}\right)$$

or

$$Y_i^* = \hat{\beta}_1^* X_{0i}^* + \hat{\beta}_2^* X_i^* + \hat{u}_i^* \tag{11.3.6}$$

Now, to obtain the GLS estimators, we minimize

$$\sum \hat{u}_i^{2*} = \sum (Y_i^* - \hat{\beta}_1^* X_{0i}^* - \hat{\beta}_2^* X_i^*)^2$$

that is,

$$\sum \left(\frac{\hat{u}_i}{\sigma_i}\right)^2 = \sum \left[\left(\frac{Y_i}{\sigma_i}\right) - \hat{\beta}_1^*\left(\frac{X_{0i}}{\sigma_i}\right) - \hat{\beta}_2^*\left(\frac{X_i}{\sigma_i}\right)\right]^2 \tag{11.3.7}$$

The actual mechanics of minimizing (11.3.7) follow the standard calculus techniques and are given in Appendix 11A, Section 11A.2. As shown there, the GLS estimator of β_2^* is

$$\hat{\beta}_2^* = \frac{(\sum w_i)(\sum w_i X_i Y_i) - (\sum w_i X_i)(\sum w_i Y_i)}{(\sum w_i)(\sum w_i X_i^2) - (\sum w_i X_i)^2} \tag{11.3.8}$$

and its variance is given by

$$\operatorname{var}(\hat{\beta}_2^*) = \frac{\sum w_i}{(\sum w_i)(\sum w_i X_i^2) - (\sum w_i X_i)^2} \tag{11.3.9}$$

where $w_i = 1/\sigma_i^2$.

Difference between OLS and GLS

Recall from Chapter 3 that in OLS we minimize

$$\sum \hat{u}_i^2 = \sum (Y_i - \hat{\beta}_1 - \hat{\beta}_2 X_i)^2 \tag{11.3.10}$$

but in GLS we minimize the expression (11.3.7), which can also be written as

$$\sum w_i \hat{u}_i^2 = \sum w_i (Y_i - \hat{\beta}_1^* - \hat{\beta}_2^* X_i)^2 \tag{11.3.11}$$

where $w_i = 1/\sigma_i^2$ [verify that (11.3.11) and (11.3.7) are identical].

Thus, in GLS we minimize a *weighted sum of residual squares* with $w_i = 1/\sigma_i^2$ acting as the weights, but in OLS we minimize an unweighted or (what amounts to the same thing) equally weighted RSS. As (11.3.7) shows, in GLS the weight assigned to each observation is inversely proportional to its σ_i, that is, observations coming from a population with larger σ_i will get relatively smaller weight and those from a population with smaller σ_i will get proportionately larger weight in minimizing the RSS (11.3.11). To see the difference between OLS and GLS clearly, consider the hypothetical scattergram given in Fig. 11.6.

In the (unweighted) OLS, each $\hat{u}_i^2$ associated with points A, B, and C will receive the same weight in minimizing the RSS. Obviously, in this case the $\hat{u}_i^2$ associated with point C will dominate the RSS. But in GLS the extreme observation C will get relatively smaller weight than the other two observations. As noted earlier, this is the right strategy, for in estimating the population regression function (PRF) more reliably we would like to give more weight to observations that are closely clustered around their (population) mean than to those that are widely scattered about.

Since (11.3.11) minimizes a weighted RSS, it is appropriately known as **weighted least squares (WLS),** and the estimators thus obtained and given in (11.3.8) and (11.3.9) are known as **WLS estimators**. But WLS is just a special case of the more general estimating technique, GLS. In the context of

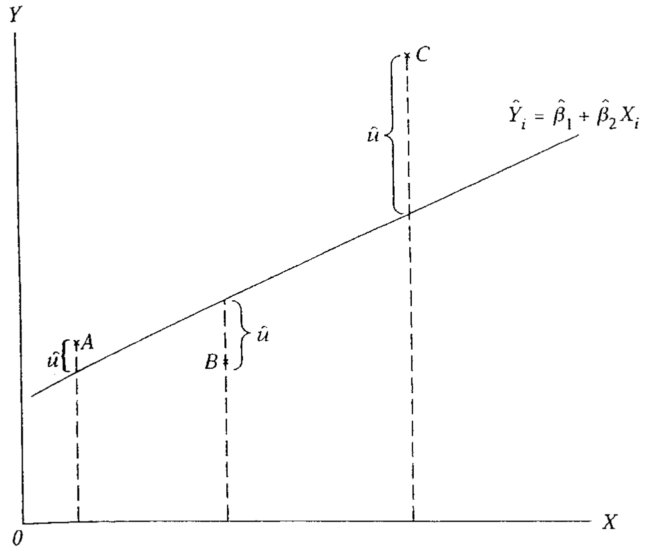


FIGURE 11.6
Hypothetical scattergram.

heteroscedasticity, one can treat the two terms WLS and GLS interchangeably. In later chapters we will come across other special cases of GLS.

In passing, note that if $w_i = w$, a constant for all i, $\hat{\beta}_2^*$ is identical with $\hat{\beta}_2$ and var($\hat{\beta}_2^*$) is identical with the usual (i.e., homoscedastic) var($\hat{\beta}_2$) given in (11.2.3), which should not be surprising. (Why?) (See exercise 11.8.)

11.4 CONSEQUENCES OF USING OLS IN THE PRESENCE OF HETEROSCEDASTICITY

As we have seen, both $\hat{\beta}_2^*$ and $\hat{\beta}_2$ are (linear) unbiased estimators: In repeated sampling, on the average, $\hat{\beta}_2^*$ and $\hat{\beta}_2$ will equal the true β_2,[3] that is, they are both unbiased estimators. But we know that it is $\hat{\beta}_2^*$ that is efficient, that is, has the smallest variance. What happens to our confidence interval, hypotheses testing, and other procedures if we continue to use the OLS estimator $\hat{\beta}_2$? We distinguish two cases.

OLS Estimation Allowing for Heteroscedasticity

Suppose we use $\hat{\beta}_2$ and use the variance formula given in (11.2.2), which takes into account heteroscedasticity explicitly. Using this variance, and assuming σ_i^2 are known, can we establish confidence intervals and test hypotheses with

[3]It can also be shown that both $\hat{\beta}_2^*$ and $\hat{\beta}_2$ are **consistent estimators**, that is, they converge to true β_2 as the sample size n increases indefinitely.

the usual t and F tests? The answer generally is no because it can be shown that $\text{var}(\hat{\beta}_2^*) \leq \text{var}(\hat{\beta}_2)$,[4] which means that confidence intervals based on the latter will be unnecessarily larger. As a result, the t and F tests are likely to give us inaccurate results in that $\text{var}(\hat{\beta}_2)$ is overly large and what appears to be a statistically insignificant coefficient (because the t value is smaller than what is appropriate) may in fact be significant if the correct confidence intervals were established on the basis of the GLS procedure.

OLS Estimation Disregarding Heteroscedasticity

The situation becomes very serious if we not only use $\hat{\beta}_2$ but also continue to use the usual (homoscedastic) variance formula given in (11.2.3) even if heteroscedasticity is present or suspected: Note that this is the more likely case of the two we discuss here, because running a standard OLS regression package and ignoring (or being ignorant of) heteroscedasticity will yield variance of $\hat{\beta}_2$ as given in (11.2.3). First of all, $\text{var}(\hat{\beta}_2)$ given in (11.2.3) is a *biased* estimator of $\text{var}(\hat{\beta}_2)$ given in (11.2.2), that is, on the average it overestimates or underestimates the latter, and *in general* we cannot tell whether the bias is positive (overestimation) or negative (underestimation) because it depends on the nature of the relationship between σ_i^2 and the values taken by the explanatory variable X, as can be seen clearly from (11.2.2) (see exercise 11.9). The bias arises from the fact that $\hat{\sigma}^2$, the conventional estimator of σ^2, namely, $\sum \hat{u}_i^2/(n-2)$ is no longer an unbiased estimator of the latter when heteroscedasticity is present. As a result, we can no longer rely on the conventionally computed confidence intervals and the conventionally employed t and F tests.[5] **In short, if we persist in using the usual testing procedures despite heteroscedasticity, whatever conclusions we draw or inferences we make may be very misleading.**

To throw more light on this topic, we refer to a **Monte Carlo** study conducted by Davidson and MacKinnon.[6] They consider the following simple model, which in our notation is

$$Y_i = \beta_1 + \beta_2 X_i + u_i \tag{11.4.1}$$

They assume that $\beta_1 = 1$, $\beta_2 = 1$, and $u_i \sim N(0, X_i^\alpha)$. As the last expression shows, they assume that the error variance is heteroscedastic and is related to the value of the regressor X with power α. If, for example, $\alpha = 1$, the error variance is proportional to the value of X; if $\alpha = 2$, the error variance is proportional to the square of the value of X, and so on. In Section 11.6 we will consider

[4]A formal proof can be found in Phoebus J. Dhrymes, *Introductory Econometrics*, Springer-Verlag, New York, 1978, pp. 110–111. In passing, note that the loss of efficiency of $\hat{\beta}_2$ [i.e., by how much $\text{var}(\hat{\beta}_2)$ exceeds $\text{var}(\hat{\beta}_2^*)$] depends on the sample values of the X variables and the value of σ_i^2.

[5]From (5.3.6) we know that the $100(1-\alpha)\%$ confidence interval for β_2 is $[\hat{\beta}_2 \pm t_{\alpha/2}\text{se}(\hat{\beta}_2)]$. But if $\text{se}(\hat{\beta}_2)$ cannot be estimated unbiasedly, what trust can we put in the conventionally computed confidence interval?

[6]Russell Davidson and James G. MacKinnon, *Estimation and Inference in Econometrics*, Oxford University Press, New York, 1993, pp. 549–550.

the logic behind such a procedure. Based on 20,000 replications and allowing for various values for α, they obtain the standard errors of the two regression coefficients using OLS [see Eq. (11.2.3)], OLS allowing for heteroscedasticity [see Eq. (11.2.2)], and GLS [see Eq. (11.3.9)]. We quote their results for selected values of α:

	Standard error of $\hat{\beta}_1$			Standard error of $\hat{\beta}_2$		
Value of α	**OLS**	**$OLS_{het.}$**	**GLS**	**OLS**	**$OLS_{het.}$**	**GLS**
0.5	0.164	0.134	0.110	0.285	0.277	0.243
1.0	0.142	0.101	0.048	0.246	0.247	0.173
2.0	0.116	0.074	0.0073	0.200	0.220	0.109
3.0	0.100	0.064	0.0013	0.173	0.206	0.056
4.0	0.089	0.059	0.0003	0.154	0.195	0.017

Note: $OLS_{het.}$ means OLS allowing for heteroscedasticity.

The most striking feature of these results is that OLS, with or without correction for heteroscedasticity, consistently overestimates the true standard error obtained by the (correct) GLS procedure, especially for large values of α, thus establishing the superiority of GLS. These results also show that if we do not use GLS and rely on OLS—allowing for or not allowing for heteroscedasticity—the picture is mixed. The usual OLS standard errors are either too large (for the intercept) or generally too small (for the slope coefficient) in relation to those obtained by OLS allowing for heteroscedasticity. The message is clear: In the presence of heteroscedasticity, use GLS. However, for reasons explained later in the chapter, in practice it is not always easy to apply GLS.

From the preceding discussion it is clear that heteroscedasticity is potentially a serious problem and the researcher needs to know whether it is present in a given situation. If its presence is detected, then one can take corrective action, such as using the weighted least-squares regression or some other technique. Before we turn to examining the various corrective procedures, however, we must first find out whether heteroscedasticity is present or likely to be present in a given case. This topic is discussed in the following section.

11.5 DETECTION OF HETEROSCEDASTICITY

As with multicollinearity, the important practical question is: How does one know that heteroscedasticity is present in a specific situation? Again, as in the case of multicollinearity, there are no hard-and-fast rules for detecting heteroscedasticity, only a few rules of thumb. But this situation is inevitable because σ_i^2 can be known only if we have the entire Y population corresponding to the chosen X's, such as the population shown in Table 2.1 or Table 11.1. But such data are an exception rather than the rule in most economic investigations. In this respect the econometrician differs from scientists in fields such as agriculture and biology, where researchers have a good deal of control over their subjects. More often than not, in economic studies there is only one sample Y value corresponding to a particular value of X. And there is no way one can know σ_i^2 from just one Y observation. Therefore, in most cases involving econometric investigations, heteroscedasticity may be a matter of intuition, educated guesswork, prior empirical experience, or sheer speculation.

With the preceding caveat in mind, let us examine some of the informal and formal methods of detecting heteroscedasticity. As the following discussion will reveal, most of these methods are based on the examination of the OLS residuals $\hat{u}_i$ since they are the ones we observe, and not the disturbances u_i. One hopes that they are good estimates of u_i, a hope that may be fulfilled if the sample size is fairly large.

Informal Methods

Nature of the problem. Very often the nature of the problem under consideration suggests whether heteroscedasticity is likely to be encountered. For example, following the pioneering work of Prais and Houthakker on family budget studies, where they found that the residual variance around the regression of consumption on income increased with income, one now generally assumes that in similar surveys one can expect unequal variances among the disturbances.[7] As a matter of fact, in cross-sectional data involving heterogeneous units, heteroscedasticity may be the rule rather than the exception. Thus, in a cross-sectional analysis involving the investment expenditure in relation to sales, rate of interest, etc., heteroscedasticity is generally expected if small-, medium-, and large-size firms are sampled together.

Graphical method. If there is no a priori or empirical information about the nature of heteroscedasticity, in practice one can do the regression analysis on the assumption that there is no heteroscedasticity and then do a postmortem examination of the residual squared $\hat{u}_i^2$ to see if they exhibit any systematic pattern. Although $\hat{u}_i^2$ are not the same thing as u_i^2, they can be used as proxies especially if the sample size is sufficiently large.[8] An examination of the $\hat{u}_i^2$ may reveal patterns such as those shown in Fig. 11.7.

In Fig. 11.7, $\hat{u}_i^2$ are plotted against $\hat{Y}_i$, the estimated Y_i from the regression line, the idea being to find out whether the estimated mean value of Y is systematically related to the squared residual. In Fig. 11.7*a* we see that there is no systematic pattern between the two variables, suggesting that perhaps no heteroscedasticity is present in the data. Figures 11.7*b* to *e*, however, exhibit definite patterns. For instance, Fig. 11.7*c* suggests a linear relationship, whereas Figs. 11.7*d* and *e* indicate a quadratic relationship between $\hat{u}_i^2$ and $\hat{Y}_i$. Using such knowledge, albeit informal, one may transform the data in such a manner that the transformed data do not exhibit heteroscedasticity. In Section 11.6 we shall examine several such transformations.

Instead of plotting $\hat{u}_i^2$ against $\hat{Y}_i$, one may plot them against one of the explanatory variables, especially if plotting $\hat{u}_i^2$ against $\hat{Y}_i$ results in the pattern

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[7] S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge University Press, New York, 1955.

[8] For the relationship between $\hat{u}_i$ and u_i, see E. Malinvaud, *Statistical Methods of Econometrics*, North Holland Publishing Company, Amsterdam, 1970, pp. 88–89.

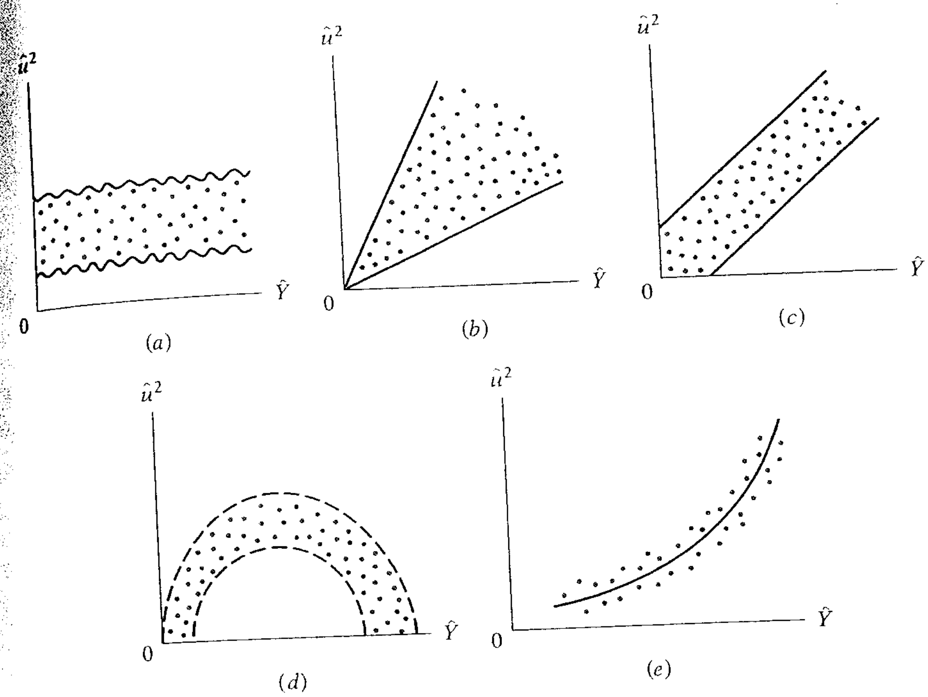

FIGURE 11.7
Hypothetical patterns of estimated squared residuals.

shown in Fig. 11.7*a*. Such a plot, which is shown in Fig. 11.8, may reveal patterns similar to those given in Fig. 11.7. (In the case of the two-variable model, plotting $\hat{u}_i^2$ against $\hat{Y}_i$ is equivalent to plotting it against X_i, and therefore Fig. 11.8 is similar to Fig. 11.7. But this is not the situation when we consider a model involving two or more X variables; in this instance, $\hat{u}_i^2$ may be plotted against any X variable included in the model.)

A pattern such as that shown in Fig. 11.8*c*, for instance, suggests that the variance of the disturbance term is linearly related to the X variable. Thus, if in the regression of savings on income one finds a pattern such as that shown in Fig. 11.8*c*, it suggests that the heteroscedastic variance may be *proportional* to the value of the income variable. This knowledge may help us in transforming our data in such a manner that in the regression on the transformed data the variance of the disturbance is homoscedastic. We shall return to this topic in the next section.

Formal Methods

Park test.[9] Park formalizes the graphical method by suggesting that σ_i^2 is some function of the explanatory variable X_i. The functional form he suggested

[9]R. E. Park, "Estimation with Heteroscedastic Error Terms," *Econometrica*, vol. 34, no. 4, October 1966, p. 888. The Park test is a special case of the general test proposed by A. C. Harvey in "Estimating Regression Models with Multiplicative Heteroscedasticity," *Econometrica*, vol. 44, no. 3, 1976, pp. 461–465.

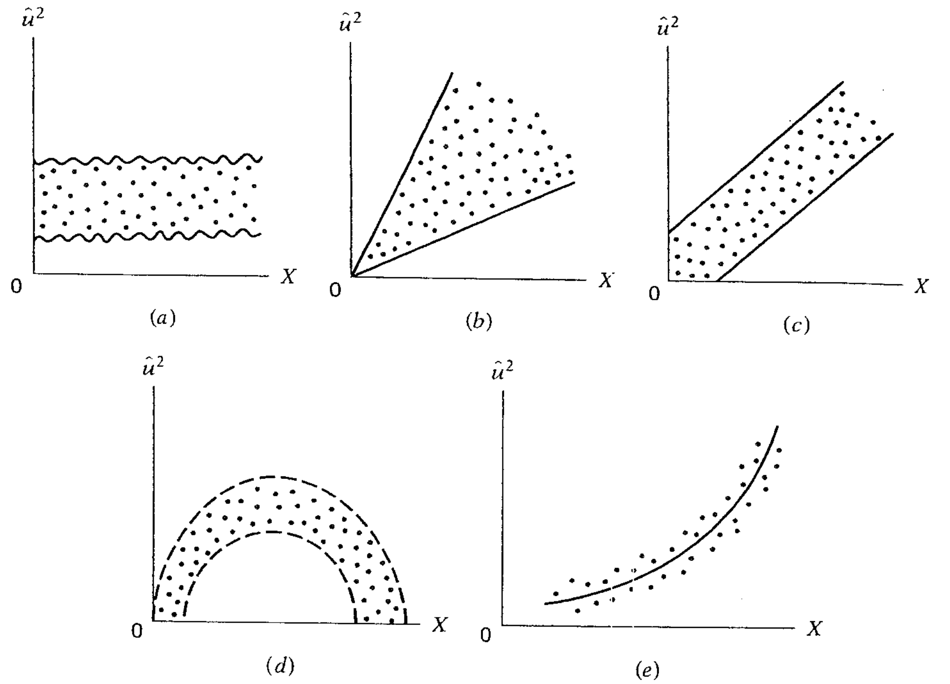

FIGURE 11.8
Scattergram of estimated squared residuals against X.

was

$$\sigma_i^2 = \sigma^2 X_i^{\beta} e^{v_i}$$

or

$$\ln \sigma_i^2 = \ln \sigma^2 + \beta \ln X_i + v_i \tag{11.5.1}$$

where v_i is the stochastic disturbance term.

Since σ_i^2 is generally not known, Park suggests using $\hat{u}_i^2$ as a proxy and running the following regression:

$$\begin{aligned} \ln \hat{u}_i^2 &= \ln \sigma^2 + \beta \ln X_i + v_i \\ &= \alpha + \beta \ln X_i + v_i \end{aligned} \tag{11.5.2}$$

If β turns out to be statistically significant, it would suggest that heteroscedasticity is present in the data. If it turns out to be insignificant, we may accept the assumption of homoscedasticity. The Park test is thus a two-stage procedure. In the first stage we run the OLS regression disregarding the heteroscedasticity question. We obtain $\hat{u}_i$ from this regression, and then in the second stage we run the regression (11.5.2).

Although empirically appealing, the Park test has some problems. Goldfeld and Quandt have argued that the error term v_i entering into (11.5.2) may not satisfy the OLS assumptions and may itself be heteroscedastic.[10] Nonetheless, as a strictly exploratory method, one may use the Park test.

[10] Stephen M. Goldfeld and Richard E. Quandt, *Nonlinear Methods in Econometrics*, North Holland Publishing Company, Amsterdam, 1972, pp. 93–94.

Example 11.1. Relationship between compensation and productivity. To illustrate the Park approach, we use the data given in Table 11.1 to run the following regression:

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

where Y = average compensation in thousands of dollars, X = average productivity in thousands of dollars, and i = ith employment size of the establishment. The results of the regression were as follows:

$$\begin{aligned} \hat{Y}_i &= 1992.3452 + 0.2329X_i \\ \text{se} &= (936.4791) \quad (0.0998) \\ t &= (2.1275) \quad (2.333) \qquad R^2 = 0.4375 \end{aligned} \tag{11.5.3}$$

The results reveal that the estimated slope coefficient is significant at the 5% level on the basis of a one-tail t test. The equation shows that as labor productivity increases by, say, a dollar, labor compensation on the average increases by about 23 cents.

The residuals obtained from regression (11.5.3) were regressed on X_i as suggested in Eq. (11.5.2), giving the following results:

$$\begin{aligned} \ln \hat{u}_i^2 &= 35.817 - 2.8099 \ln X_i \\ \text{se} &= (38.319) \quad (4.216) \\ t &= (0.934) \, (-0.667) \qquad R^2 = 0.0595 \end{aligned} \tag{11.5.4}$$

Obviously, there is no statistically significant relationship between the two variables. Following the Park test, one may conclude that there is no heteroscedasticity in the error variance.[11]

Glejser test.[12] The Glejser test is similar in spirit to the Park test. After obtaining the residuals $\hat{u}_i$ from the OLS regression, Glejser suggests regressing the absolute values of $\hat{u}_i$ on the X variable that is thought to be closely associated with σ_i^2. In his experiments, Glejser used the following functional forms:

$$|\hat{u}_i| = \beta_1 + \beta_2 X_i + v_i$$

$$|\hat{u}_i| = \beta_1 + \beta_2 \sqrt{X_i} + v_i$$

$$|\hat{u}_i| = \beta_1 + \beta_2 \frac{1}{X_i} + v_i$$

$$|\hat{u}_i| = \beta_1 + \beta_2 \frac{1}{\sqrt{X_i}} + v_i$$

$$|\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i} + v_i$$

$$|\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i^2} + v_i$$

where v_i is the error term.

---

[11] The particular functional form chosen by Park is only suggestive. A different functional form may reveal significant relationships. For example, one may use $\hat{u}_i^2$ instead of $\ln \hat{u}_i^2$ as the dependent variable.

[12] H. Glejser, "A New Test for Heteroscedasticity," *Journal of the American Statistical Association*, vol. 64, 1969, pp. 316–323.

Again as an empirical or practical matter, one may use the Glejser approach. But Goldfeld and Quandt point out that the error term v_i has some problems in that its expected value is nonzero, it is serially correlated (see Chapter 12), and ironically it is heteroscedastic.[13] An additional difficulty with the Glejser method is that models such as

$$|\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i} + v_i \quad \text{and} \quad |\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i^2} + v_i$$

are nonlinear in the parameters and therefore cannot be estimated with the usual OLS procedure.

Glejser has found that for large samples the first four of the preceding models give generally satisfactory results in detecting heteroscedasticity. As a practical matter, therefore, the Glejser technique may be used for large samples and may be used in the small samples strictly as a qualitative device to learn something about heteroscedasticity. For an application of the Glejser method, see Section 11.7.

Spearman's rank correlation test. In exercise 3.8 we defined the Spearman's rank correlation coefficient as

$$r_s = 1 - 6\left[\frac{\sum d_i^2}{n(n^2 - 1)}\right] \tag{11.5.5}$$

where d_i = difference in the ranks assigned to two different characteristics of the ith individual or phenomenon and n = number of individuals or phenomena ranked. The preceding rank correlation coefficient can be used to detect heteroscedasticity as follows: Assume $Y_i = \beta_0 + \beta_1 X_i + u_i$.

Step 1. Fit the regression to the data on Y and X and obtain the residuals $\hat{u}_i$.

Step 2. Ignoring the sign of $\hat{u}_i$, that is, taking their absolute value $|\hat{u}_i|$, rank both $|\hat{u}_i|$ and X_i (or $\hat{Y}_i$) according to an ascending or descending order and compute the Spearman's rank correlation coefficient given previously.

Step 3. Assuming that the population rank correlation coefficient ρ_s is zero and $n > 8$, the significance of the sample r_s can be tested by the t test as follows:[14]

$$t = \frac{r_s\sqrt{n-2}}{\sqrt{1 - r_s^2}} \tag{11.5.6}$$

with df $= n - 2$.

[13] For details, see Goldfeld and Quandt, op. cit., Chap. 3.

[14] See G. Udny Yule and M. G. Kendall, *An Introduction to the Theory of Statistics*, Charles Griffin & Company, London, 1953, p. 455.

If the computed t value exceeds the critical t value, we may accept the hypothesis of heteroscedasticity; otherwise we may reject it. If the regression model involves more than one X variable, r_s can be computed between $|\hat{u}_i|$ and each of the X variables separately and can be tested for statistical significance by the t test given in Eq. (11.5.6).

Example 11.2. Illustration of the rank correlation test. To illustrate the rank correlation test, consider the data given in Table 11.2, which are a subsample from the data of the table pertaining to exercise 5.16, which asks you to estimate the capital market line of the portfolio theory, namely, $E_i = \beta_1 + \beta_2\sigma_i$, where E is expected return on portfolio and σ is the standard deviation of return. Since the data relate to 10 mutual funds of differing sizes and investment goals, a priori one might expect heteroscedasticity. To test this hypothesis, we apply the rank correlation technique. The necessary calculations are also shown in Table 11.2.

Applying formula (11.5.5), we obtain

$$r_s = 1 - 6\frac{110}{10(100-1)} = 0.3333 \tag{11.5.7}$$

Applying the t test given in (11.5.6), we obtain

$$t = \frac{(0.3333)(\sqrt{8})}{\sqrt{1-0.1110}} = 0.9998 \tag{11.5.8}$$

TABLE 11.2
Rank correlation test of heteroscedasticity

Name of mutual fund	E_i, average annual return, %	σ_i, standard deviation of annual return, %	$\hat{E}_i$*	$\lvert\hat{u}_i\rvert$† residuals, $\lvert(E_i - \hat{E}_i)\rvert$	Rank of $\lvert\hat{u}_i\rvert$	Rank of σ_i	d, difference between two rankings	d^2
Boston Fund	12.4	12.1	11.37	1.03	9	4	5	25
Delaware Fund	14.4	21.4	15.64	1.24	10	9	1	1
Equity Fund	14.6	18.7	14.40	0.20	4	7	−3	9
Fundamental Investors	16.0	21.7	15.78	0.22	5	10	−5	25
Investors Mutual	11.3	12.5	11.56	0.26	6	5	1	1
Loomis-Sales Mutual Fund	10.0	10.4	10.59	0.59	7	2	5	25
Massachusetts Investors Trust	16.2	20.8	15.37	0.83	8	8	0	0
New England Fund	10.4	10.2	10.50	0.10	3	1	2	4
Putnam Fund of Boston	13.1	16.0	13.16	0.06	2	6	−4	16
Wellington Fund	11.3	12.0	11.33	0.03	1	3	−2	4
Total							0	110

*Obtained from the regression: $\hat{E}_i = 5.8194 + 0.4590\sigma_i$.

†Absolute value of the residuals.

Note: The ranking is in ascending order of values.

For 8 df this t value is not significant even at the 10% level of significance; the **p value** is 0.17. Thus, there is no evidence of a systematic relationship between the explanatory variable and the absolute values of the residuals, which might suggest that there is no heteroscedasticity.

Goldfeld-Quandt test.[15] This popular method is applicable if one assumes that the heteroscedastic variance, σ_i^2, is positively related to *one* of the explanatory variables in the regression model. For simplicity, consider the usual two-variable model:

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

Suppose σ_i^2 is positively related to X_i as

$$\sigma_i^2 = \sigma^2 X_i^2 \tag{11.5.9}$$

where σ^2 is a constant.[16]

Assumption (11.5.9) postulates that σ_i^2 is proportional to the square of the X variable. Such an assumption has been found quite useful by Prais and Houthakker in their study of family budgets. (See Section 11.6.)

If (11.5.9) is appropriate, it would mean σ_i^2 would be larger, the larger the values of X_i. If that turns out to be the case, heteroscedasticity is most likely to be present in the model. To test this explicitly, Goldfeld and Quandt suggest the following steps:

Step 1. Order or rank the observations according to the values of X_i, beginning with the lowest X value.

Step 2. Omit c central observations, where c is specified a priori, and divide the remaining $(n - c)$ observations into two groups each of $(n - c)/2$ observations.

Step 3. Fit separate OLS regressions to the first $(n - c)/2$ observations and the last $(n - c)/2$ observations, and obtain the respective residual sums of squares RSS_1 and RSS_2, RSS_1 representing the RSS from the regression corresponding to the smaller X_i values (the small variance group) and RSS_2 that from the larger X_i values (the large variance group). These RSS each have

$$\frac{(n-c)}{2} - k \quad \text{or} \quad \left(\frac{n-c-2k}{2}\right) \text{df}$$

where k is the number of parameters to be estimated, including the intercept. (Why?) For the two-variable case k is of course 2.

Step 4. Compute the ratio

$$\lambda = \frac{RSS_2/\text{df}}{RSS_1/\text{df}} \tag{11.5.10}$$

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[15] Goldfeld and Quandt, op. cit., Chap. 3.

[16] This is only one plausible assumption. Actually, what is required is that σ_i^2 be monotonically related to X_i.

> *If u_i are assumed to be normally distributed* (which we usually do), and *if the assumption of homoscedasticity is valid,* then it can be shown that λ of (11.5.10) follows the F distribution with numerator and denominator df each of $(n - c - 2k)/2$.

If in an application the computed $\lambda(= F)$ is greater than the critical F at the chosen level of significance, we can reject the hypothesis of homoscedasticity, that is, we can say that heteroscedasticity is very likely.

Before illustrating the test, a word about omitting the c central observations is in order. These observations are omitted to sharpen or accentuate the difference between the small variance group (i.e., RSS_1) and the large variance group (i.e., RSS_2). But the ability of the Goldfeld-Quandt test to do this successfully depends on how c is chosen.[17] For the two-variable model the Monte Carlo experiments done by Goldfeld and Quandt suggest that c is about 8 if the sample size is about 30, and it is about 16 if the sample size is about 60. But Judge et al. note that $c = 4$ if $n = 30$ and $c = 10$ if n is about 60 have been found satisfactory in practice.[18]

Before moving on, it may be noted that in case there is more than one X variable in the model, the ranking of observations, the first step in the test, can be done according to any one of them. Thus in the model: $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + u_i$, we can rank-order the data according to any one of these X's. If a priori we are not sure which X variable is appropriate, we can conduct the test on each of the X variables, or via a Park test, in turn, on each X.

Example 11.3. The Goldfeld-Quandt test. To illustrate the Goldfeld-Quandt test, we present in Table 11.3 data on consumption expenditure in relation to income for a cross section of 30 families. Suppose we postulate that consumption expenditure is linearly related to income but that heteroscedasticity is present in the data. We further postulate that the nature of heteroscedasticity is as given in (11.5.9). The necessary reordering of the data for the application of the test is also presented in Table 11.3.

Dropping the middle 4 observations, the OLS regressions based on the first 13 and the last 13 observations and their associated residual sums of squares are as shown next (standard errors in the parentheses).

Regression based on the first 13 observations:

$$\hat{Y}_i = \underset{(8.7049)}{3.4094} + \underset{(0.0744)}{0.6968}X_i \qquad r^2 = 0.8887$$

$$\text{RSS}_1 = 377.17$$

$$\text{df} = 11$$

---

[17]Technically, the **power** of the test depends on how c is chosen. In statistics, the *power of a test* is measured by the probability of rejecting the null hypothesis when it is false [i.e., by 1 − Prob (type II error)]. Here the null hypothesis is that the variances of the two groups are the same, i.e., homoscedasticity. For further discussion, see M. M. Ali and C. Giaccotto, "A Study of Several New and Existing Tests for Heteroscedasticity in the General Linear Model," *Journal of Econometrics*, vol. 26, 1984, pp. 355–373.

[18]George G. Judge, R. Carter Hill, William E. Griffiths, Helmut Lütkepohl, and Tsoung-Chao Lee, *Introduction to the Theory and Practice of Econometrics*, John Wiley & Sons, New York, 1982, p. 422.

TABLE 11.3
Hypothetical data on consumption expenditure Y($) and income X($) to illustrate the Goldfeld-Quandt test

		Data ranked by X values		
Y	X	Y	X	
55	80	55	80	
65	100	70	85	
70	85	75	90	
80	110	65	100	
79	120	74	105	
84	115	80	110	
98	130	84	115	
95	140	79	120	
90	125	90	125	
75	90	98	130	
74	105	95	140	
110	160	108	145	
113	150	113	150	
125	165	110	160	Middle 4 observations
108	145	125	165	
115	180	115	180	
140	225	130	185	
120	200	135	190	
145	240	120	200	
130	185	140	205	
152	220	144	210	
144	210	152	220	
175	245	140	225	
180	260	137	230	
135	190	145	240	
140	205	175	245	
178	265	189	250	
191	270	180	260	
137	230	178	265	
189	250	191	270	

Regression based on the last 13 observations:

$$\hat{Y}_i = -28.0272 + 0.7941X_i$$
$$(30.6421) \quad (0.1319) \qquad r^2 = 0.7681$$
$$\text{RSS}_2 = 1536.8$$
$$\text{df} = 11$$

From these results we obtain

$$\lambda = \frac{\text{RSS}_2/\text{df}}{\text{RSS}_1/\text{df}} = \frac{1536.8/11}{377.17/11}$$
$$\lambda = 4.07$$

The critical F value for 11 numerator and 11 denominator df at the 5% level is 2.82. Since the estimated $F(=\lambda)$ value exceeds the critical value, we may conclude that there is heteroscedasticity in the error variance. However, if the level of significance is fixed at 1 percent, we may not reject the assumption of homoscedasticity. (Why?) Note that the p value of the observed λ is 0.014.

Breusch-Pagan-Godfrey test.[19] The success of the Goldfeld-Quandt test depends not only on the value of c (the number of central observations to be omitted) but also on identifying the correct X variable with which to order the observations. This limitation of this test can be avoided if we consider the **Breusch-Pagan-Godfrey (BPG) test.**

To illustrate this test, consider the k-variable linear regression model

$$Y_i = \beta_1 + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i \tag{11.5.11}$$

Assume that the error variance σ_i^2 is described as

$$\sigma_i^2 = f(\alpha_1 + \alpha_2 Z_{2i} + \cdots + \alpha_m Z_{mi}) \tag{11.5.12}$$

that is, σ_i^2 is some function of the nonstochastic variables Z's; some or all of the X's can serve as Z's. Specifically, assume that

$$\sigma_i^2 = \alpha_1 + \alpha_2 Z_{2i} + \cdots + \alpha_m Z_{mi} \tag{11.5.13}$$

that is, σ_i^2 is a linear function of the Z's. If $\alpha_2 = \alpha_3 = \cdots = \alpha_m = 0$, $\sigma_i^2 = \alpha_1$, which is a constant. Therefore, to test whether σ_i^2 is homoscedastic, one can test the hypothesis that $\alpha_2 = \alpha_3 = \cdots = \alpha_m = 0$. This is the basic idea behind the Breusch-Pagan test. The actual test procedure is as follows.

Step 1. Estimate (11.5.11) by OLS and obtain the residuals $\hat{u}_1, \hat{u}_2, \ldots, \hat{u}_n$.

Step 2. Obtain $\tilde{\sigma}^2 = \sum \hat{u}_i^2/n$. Recall from Chapter 4 that this is the maximum likelihood (ML) estimator of σ^2. [*Note:* The OLS estimator is $\sum \hat{u}_i^2/(n-k)$.]

Step 3. Construct variables p_i defined as

$$p_i = \hat{u}_i^2/\tilde{\sigma}^2$$

which is simply each residual squared divided by $\tilde{\sigma}^2$.

Step 4. Regress p_i thus constructed on the Z's as

$$p_i = \alpha_1 + \alpha_2 Z_{2i} + \cdots + \alpha_m Z_{mi} + v_i \tag{11.5.14}$$

where v_i is the residual term of this regression.

Step 5. Obtain the ESS (explained sum of squares) from (11.5.14) and define

$$\Theta = \tfrac{1}{2}(\text{ESS}) \tag{11.5.15}$$

[19] T. Breusch and A. Pagan, "A Simple Test for Heteroscedasticity and Random Coefficient Variation," *Econometrica*, vol. 47, 1979, pp. 1287–1294. See also L. Godfrey, "Testing for Multiplicative Heteroscedasticity," *Journal of Econometrics*, vol. 8, 1978, pp. 227–236. Because of similarity, these tests are known as Breusch-Pagan-Godfrey tests of heteroscedasticity.

Assuming u_i are normally distributed, one can show that if there is homoscedasticity and if the sample size n increases indefinitely, then

$$\Theta \underset{\text{asy}}{\sim} \chi^2_{m-1} \tag{11.5.16}$$

that is, Θ follows the chi-square distribution with $(m - 1)$ degrees of freedom. (*Note: asy* means asymptotically.)

Therefore, if in an application the computed $\Theta (= \chi^2)$ exceeds the critical χ^2 value at the chosen level of significance, one can reject the hypothesis of homoscedasticity; otherwise one does not reject it.

Example 11.4. The Breusch-Pagan-Godfrey test. As an example, let us revisit the data (Table 11.3) that were used to illustrate the Goldfeld-Quandt heteroscedasticity test. Regressing Y on X, we obtain the following:

Step 1.

$$\begin{aligned} \hat{Y}_i &= 9.2903 + 0.6378X_i \\ \text{se} &= (5.2314) \quad (0.0286) \qquad \text{RSS} = 2361.153 \\ & \qquad\qquad\qquad\qquad\quad R^2 = 0.9466 \end{aligned} \tag{11.5.17}$$

Step 2.

$$\tilde{\sigma}^2 = \sum \hat{u}_i^2/30 = 2361.153/30 = 78.7051$$

Step 3. Divide the residuals $\hat{u}_i$ obtained from regression (11.5.17) by 78.7051 to construct the variable p_i.

Step 4. Assuming that p_i are linearly related to $X_i (= Z_i)$ as per (11.5.13), we obtain the regression

$$\begin{aligned} \hat{p}_i &= -0.7426 + 0.0101X_i \\ \text{se} &= \quad (0.7529) \quad (0.0041) \qquad \text{ESS} = 10.4280 \\ & \qquad\qquad\qquad\qquad\quad R^2 = 0.18 \end{aligned} \tag{11.5.18}$$

Step 5.

$$\Theta = \tfrac{1}{2}(\text{ESS}) = 5.2140 \tag{11.5.19}$$

Under the assumptions of the BPG test Θ in (11.5.19) asymptotically follows the chi-square distribution with 1 df. [*Note:* There is only one regressor in (11.5.18).] Now from the chi-square table we find that for 1 df the 5% critical chi-square value is 3.8414 and the 1% critical F value is 6.6349. Thus, the observed chi-square value of 5.2140 is significant at the 5% but not the 1% level of significance. Therefore, we reach the same conclusion as the Goldfeld-Quandt test. But keep in mind that, strictly speaking, the BPG test is an asymptotic, or large-sample, test and in the present example 30 observations may not constitute a large sample. It should also be pointed out that in small samples the test is sensitive to the assumption that the disturbances u_i are normally distributed. Of course, we can test the normality assumption by the chi-square or **Bera-Jarque** tests discussed previously.[20]

[20]On this, see R. Koenker, "A Note on Studentizing a Test for Heteroscedasticity," *Journal of Econometrics*, vol. 17, 1981, pp. 1180–1200.

White's general heteroscedasticity test. Unlike the Goldfeld-Quandt test, which requires reordering the observations with respect to the X variable that supposedly caused heteroscedasticity, or the BGP test, which is sensitive to the normality assumption, the general test of heteroscedasticity proposed by White does not rely on the normality assumption and is easy to implement.[21] As an illustration of the basic idea, consider the following three-variable regression model (the generalization to the k-variable model is straightforward):

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i \tag{11.5.20}$$

The White test proceeds as follows:

Step 1. Given the data, we estimate (11.5.20) and obtain the residuals, $\hat{u}_i$.

Step 2. We then run the following (*auxiliary*) regression:

$$\hat{u}_i^2 = \alpha_1 + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{2i}^2 + \alpha_5 X_{3i}^2 + \alpha_6 X_{2i} X_{3i} + v_i \qquad (11.5.21)^{22}$$

That is, the squared residuals from the original regression are regressed on the original X variables or regressors, their squared values, and the cross product(s) of the regressors. Higher powers of regressors can also be introduced. Note that there is a constant term in this equation even though the original regression may or may not contain it. Obtain the R^2 from this (auxiliary) regression.

Step 3. Under the null hypothesis that there is no heteroscedasticity, it can be shown that sample size (n) times the R^2 obtained from the auxiliary regression *asymptotically* follows the chi-square distribution with df equal to the number of regressors (excluding the constant term) in the auxiliary regression. That is,

$$n \cdot R^2 \underset{\text{asy}}{\sim} \chi^2_{\text{df}} \tag{11.5.22}$$

where df is as defined previously. In our example, there are 5 df since there are 5 regressors in the auxiliary regression.

Step 4. If the chi-square value obtained in (11.5.22) exceeds the critical chi-square value at the chosen level of significance, the conclusion is that there is heteroscedasticity. If it does not exceed the critical chi-square value, there is no heteroscedasticity, which is to say that in the auxiliary regression (11.5.21), $\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0$ (see footnote 22).

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[21] H. White, "A Heteroscedasticity Consistent Covariance Matrix Estimator and a Direct Test of Heteroscedasticity," *Econometrica*, vol. 48, 1980, pp. 817–818.

[22] Implied in this procedure is the assumption that the error variance of u_i, σ_i^2, is functionally related to the regressors, their squares, and their cross products. If all the partial slope coefficients in this regression are simultaneously equal to zero, then the error variance is the homoscedastic constant equal to α_1.

Example 11.5. White's heteroscedasticity test. Based on cross-sectional data on 41 countries, Stephen Lewis estimated the following regression model:[23]

$$\ln Y_i = \beta_1 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + u_i \tag{11.5.23}$$

where Y = ratio of trade taxes (import and export taxes) to total government revenue, X_2 = ratio of the sum of exports plus imports to GNP, and X_3 = GNP per capita; and ln stands for natural log. His hypotheses were that Y and X_2 would be positively related (the higher the trade volume, the higher the trade tax revenue) and that Y and X_3 would be negatively related (as income increases, government finds it is easier to collect direct taxes—e.g., income tax—than rely on trade taxes).

The empirical results supported the hypotheses. For our purpose, the important point is whether there is heteroscedasticity in the data. Since the data are cross-sectional involving a heterogeneity of countries, a priori one would expect heteroscedasticity in the error variance. By applying **White's heteroscedasticity test** to the residuals obtained from regression (11.5.23), the following results were obtained:[24]

$$\begin{aligned}\hat{u}_i^2 = &-5.8417 + 2.5629 \ln \text{Trade}_i + 0.6918 \ln \text{GNP}_i \\ &-0.4081(\ln \text{Trade}_i)^2 - 0.0491(\ln \text{GNP}_i)^2 \\ &+0.0015(\ln \text{Trade}_i)(\ln \text{GNP}_i) \qquad R^2 = 0.1148\end{aligned} \tag{11.5.24}$$

Note: The standard errors are not given, as they are not pertinent for our purpose here.

Now $n \cdot R^2 = 41(0.1148) = 4.7068$, which has, asymptotically, a chi-square distribution with 5 df (why?). The 5% critical chi-square value for 5 df is 11.0705, the 10% critical value is 9.2363, and the 25% critical value is 6.62568. For all practical purposes, one can conclude, on the basis of the White test, that there is no heteroscedasticity.

A comment is in order regarding the White test. If a model has several regressors, then introducing all the regressors, their squared (or higher powered) terms, and their cross products can quickly consume degrees of freedom. Therefore, one must exercise caution in using the test. Sometimes one can omit the cross product terms. In cases where the test statistic is significant, heteroscedasticity may not necessarily be the cause, but specification errors, about which more will be said in Chapter 13 (recall Point #5 of Sec. 11.1). In other words, **the White test can be a test of (pure) heteroscedasticity or specification error or both.**

Other tests of heteroscedasticity. There are several other tests of heteroscedasticity, each based on certain assumptions. The interested reader may want to consult the references.[25]

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[23] Stephen R. Lewis, "Government Revenue from Foreign Trade," *Manchester School of Economics and Social Studies*, vol. 31, 1963, pp. 39–47.

[24] These results, with change in notation, are reproduced from William F. Lott and Subhash C. Ray, *Applied Econometrics: Problems with Data Sets*, Instructor's Manual, Chap. 22, pp. 137–140.

[25] See M. J. Harrison and B. P. McCabe, "A Test for Heteroscedasticity Based on Ordinary Least Squares Residuals," *Journal of the American Statistical Association*, vol. 74, 1979, pp. 494–499; J. Szroeter, "A Class of Parametric Tests for Heteroscedasticity in Linear Econometric Models," *Econometrica*, vol. 46, 1978, pp. 1311–1327; M. A. Evans and M. L. King, "A Further Class of Tests for Heteroscedasticity," *Journal of Econometrics*, vol. 37, 1988, pp. 265–276.

11.6 REMEDIAL MEASURES

As we have seen, heteroscedasticity does not destroy the unbiasedness and consistency properties of the OLS estimators, but they are no longer efficient, not even asymptotically (i.e., large sample size). This lack of efficiency makes the usual hypothesis-testing procedure of dubious value. Therefore, remedial measures are clearly called for. There are two approaches to remediation: when σ_i^2 is known and when σ_i^2 is not known.

When σ_i^2 Is Known: The Method of Weighted Least Squares

As we have seen in Section 11.3, if σ_i^2 is known, the most straightforward method of correcting heteroscedasticity is by means of weighted least squares, for the estimators thus obtained are BLUE.

Example 11.6. Illustration of the method of weighted least squares. To illustrate the method, suppose we want to study the relationship between compensation and employment size for the data presented in Table 11.1. For simplicity, we measure employment size by 1 (1–4 employees), 2 (5–9 employees), . . . , 9 (1000–2499 employees), although we could also measure it by the midpoint of the various employment classes given in the table (see exercise 11.21.)

Now letting Y represent average compensation per employee ($) and X the employment size, we run the following regression [see Eq. (11.3.6)]:

$$Y_i/\sigma_i = \hat{\beta}_1^*(1/\sigma_i) + \hat{\beta}_2^*(X_i/\sigma_i) + (\hat{u}_i/\sigma_i) \tag{11.6.1}$$

where σ_i are the standard deviations of wages as reported in Table 11.1. The necessary raw data to run this regression are given in Table 11.4.

Before going on to the regression results, note that (11.6.1) has no intercept term. (Why?) Therefore, one will have to use the regression-through-the-origin

TABLE 11.4
Illustration of weighted least-squares regression

Compensation, Y	Employment size, X	σ_i	Y_i/σ_i	X_i/σ_i
3396	1	743.7	4.5664	0.0013
3787	2	851.4	4.4480	0.0023
4013	3	727.8	5.5139	0.0041
4104	4	805.06	5.0978	0.0050
4146	5	929.9	4.4585	0.0054
4241	6	1080.6	3.9247	0.0055
4387	7	1243.2	3.5288	0.0056
4538	8	1307.7	3.4702	0.0061
4843	9	1112.5	4.3532	0.0081

Note: In regression (11.6.2), the dependent variable is (Y_i/σ_i) and the independent variables are $(1/\sigma_i)$ and (X_i/σ_i).

Source: Data on Y and σ_i (standard deviation of compensation) are from Table 11.1. Employment size: 1 = 1–4 employees, 2 = 5–9 employees, etc. The latter data are also from Table 11.1.

model to estimate β_1^* and β_2^*, a topic discussed in Chapter 6. But most computer packages these days have an option to suppress the intercept term (see SAS, for example). Also note another interesting feature of (11.6.1): It has two explanatory variables, $(1/\sigma_i)$ and (X_i/σ_i), whereas if we were to use OLS, regressing compensation on employment size, that regression would have a single explanatory variable, X_i. (Why?)

The regression results of WLS are as follows:

$$\begin{aligned} \widehat{(Y_i/\sigma_i)} &= 3406.639(1/\sigma_i) + 154.153(X_i/\sigma_i) \\ &\qquad (80.983) \qquad\qquad (16.959) \\ t &= \quad (42.066) \qquad\qquad (9.090) \\ &\qquad R^2 = 0.9993^{26} \end{aligned} \tag{11.6.2}$$

For comparison, we give the usual or unweighted OLS regression results:

$$\begin{aligned} \hat{Y}_i &= 3417.833 + 148.767X_i \\ &\quad (81.136) \qquad (14.418) \\ t &= \quad (42.125) \qquad (10.318) \qquad R^2 = 0.9383 \end{aligned} \tag{11.6.3}$$

In exercise 11.7 you are asked to compare these two regressions.

When σ_i^2 Is Not Known

As noted earlier, if true σ_i^2 are known, we can use the WLS method to obtain BLUE estimators. Since the true σ_i^2 are rarely known, is there a way of obtaining *consistent* (in the statistical sense) estimates of the variances and covariances of OLS estimators even if there is heteroscedasticity? The answer is yes.

White's heteroscedasticity-consistent variances and standard errors. White has shown that this estimate can be performed so that asymptotically valid (i.e., large-sample) statistical inferences can be made about the true parameter values.[27] We will not present the mathematical details, for they are beyond the scope of this book. But several computer packages (e.g., TSP, ET, SHAZAM) now present White's heteroscedasticity-corrected variances and standard errors along with the usual OLS variances and standard errors.[28]

Example 11.7. Illustration of White's procedure. As an example, we quote the following results due to Greene:[29]

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[26] As noted in footnote 3 of Chap. 6, the R^2 of the regression through the origin is not directly comparable with the R^2 of the intercept-present model. The reported R^2 of 0.9993 takes this difference into account. (See the SAS package for further details about how the R^2 is corrected to take into account the absence of the intercept term. See also App. 6A, Sec. 6A1.)

[27] See H. White, op. cit.

[28] More technically, they are known as **heteroscedasticity-consistent covariance matrix estimators, HCCME** for short.

[29] William H. Greene, *Econometric Analysis*, 2d ed., Macmillan, New York, 1993, p. 385.

$$\begin{aligned}
\hat{Y}_i &= \ \ 832.91 \ - \ 1834.2\,(\text{Income}) + 1587.04\,(\text{Income})^2 \\
\text{OLS se} &= (327.3) \qquad (829.0) \qquad\qquad (519.1) \\
t &= \ \ (2.54) \qquad\ (2.21) \qquad\qquad\ (3.06) \qquad\qquad (11.6.4)\\
\text{White se} &= (460.9) \qquad (1243.0) \qquad\quad\ (830.0) \\
t &= \ \ (1.81) \qquad (-1.48) \qquad\qquad (1.91)
\end{aligned}$$

where Y = per capita expenditure on public schools by state in 1979 and Income = per capita income by state in 1979. The sample consisted of 50 states plus Washington, D.C.

As the preceding results show, (White's) heteroscedasticity-corrected standard errors are considerably larger than the OLS standard errors and therefore the estimated t values are much smaller than those obtained by OLS. On the basis of the latter, both the regressors are statistically significant at the 5% level, whereas on the basis of White estimators they are not. However, it should be pointed out that White's heteroscedasticity-corrected standard errors can be larger or smaller than the uncorrected standard errors.

Since White's heteroscedasticity-consistent estimators of the variances are now available in established regression packages, it is recommended that the reader report them. As Wallace and Silver note:

> Generally speaking, it is probably a good idea to use the WHITE option [available in regression programs] routinely, perhaps comparing the output with regular OLS output as a check to see whether heteroscedasticity is a serious problem in a particular set of data.[30]

Plausible assumptions about heteroscedasticity pattern. Apart from being a large-sample procedure, one drawback of the White procedure is that the estimators thus obtained may not be so efficient as those obtained by methods that transform data to reflect specific types of heteroscedasticity. To illustrate this, let us revert to the two-variable regression model:

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

We now consider several assumptions about the pattern of heteroscedasticity.

Assumption 1: The error variance is proportional to X_i^2:

$$E(u_i^2) = \sigma^2 X_i^2 \qquad (11.6.5)^{31}$$

If, as a matter of "speculation," graphical methods, or Park and Glejser approaches, it is believed that the variance of u_i is proportional to the square

[30] T. Dudley Wallace and J. Lew Silver, *Econometrics: An Introduction*, Reading, Mass., 1988, p. 265.

[31] Recall that we have already encountered this assumption in our discussion of the Goldfeld-Quandt test.

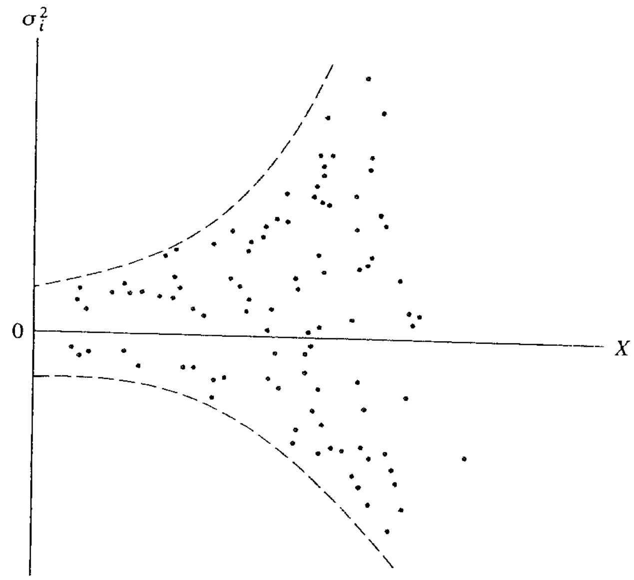


FIGURE 11.9
Error variance proportional to X^2.

of the explanatory variable X (see Fig. 11.9), one may transform the original model as follows. Divide the original model through by X_i:

$$\frac{Y_i}{X_i} = \frac{\beta_1}{X_i} + \beta_2 + \frac{u_i}{X_i}$$

$$= \beta_1 \frac{1}{X_i} + \beta_2 + v_i \qquad (11.6.6)$$

where v_i is the transformed disturbance term, equal to u_i/X_i. Now it is easy to verify that

$$E(v_i^2) = E\left(\frac{u_i}{X_i}\right)^2 = \frac{1}{X_i^2} E(u_i^2)$$

$$= \sigma^2 \quad \text{using (11.6.5)}$$

Hence the variance of v_i is now homoscedastic, and one may proceed to apply OLS to the transformed equation (11.6.6), regressing Y_i/X_i on $1/X_i$.

Notice that in the transformed regression the intercept term β_2 is the slope coefficient in the original equation and the slope coefficient β_1 is the intercept term in the original model. Therefore, to get back to the original model we shall have to multiply the estimated (11.6.6) by X_i. An application of this transformation is given in exercise 11.17.

Assumption 2: The error variance is proportional to X_i. **The square root transformation:**

$$E(u_i^2) = \sigma^2 X_i \qquad (11.6.7)$$

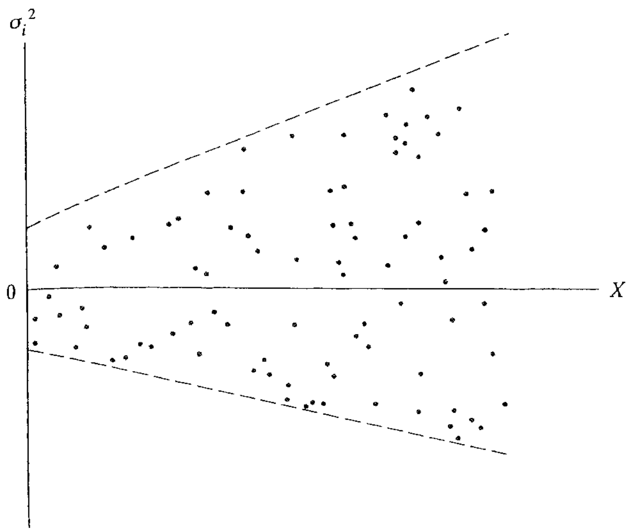


FIGURE 11.10
Error variance proportional to X.

If it is believed that the variance of u_i, instead of being proportional to the squared X_i, is proportional to X_i itself, then the original model can be transformed as follows (see Fig. 11.10):

$$\begin{aligned}\frac{Y_i}{\sqrt{X_i}} &= \frac{\beta_1}{\sqrt{X_i}} + \beta_2\sqrt{X_i} + \frac{u_i}{\sqrt{X_i}} \\ &= \beta_1\frac{1}{\sqrt{X_i}} + \beta_2\sqrt{X_i} + v_i \qquad (11.6.8)\end{aligned}$$

where $v_i = u_i/\sqrt{X_i}$ and where $X_i > 0$.

Given assumption 2, one can readily verify that $E(v_i^2) = \sigma^2$, a homoscedastic situation. Therefore, one may proceed to apply OLS to (11.6.8), regressing $Y_i/\sqrt{X_i}$ on $1/\sqrt{X_i}$ and $\sqrt{X_i}$.

Note an important feature of the transformed model: It has no intercept term. Therefore, one will have to use the regression-through-the-origin model to estimate β_1 and β_2. Having run (11.6.8), one can get back to the original model simply by multiplying (11.6.8) by $\sqrt{X_i}$.

Assumption 3: The error variance is proportional to the square of the mean value of Y.

$$E(u_i^2) = \sigma^2[E(Y_i)]^2 \qquad (11.6.9)$$

Equation (11.6.9) postulates that the variance of u_i is proportional to the square of the expected value of Y (see Fig. 11.7e). Now

$$E(Y_i) = \beta_1 + \beta_2 X_i$$

Therefore, if we transform the original equation as follows,

$$\begin{aligned}\frac{Y_i}{E(Y_i)} &= \frac{\beta_1}{E(Y_i)} + \beta_2 \frac{X_i}{E(Y_i)} + \frac{u_i}{E(Y_i)} \\ &= \beta_1 \left(\frac{1}{E(Y_i)}\right) + \beta_2 \frac{X_i}{E(Y_i)} + v_i \end{aligned} \tag{11.6.10}$$

where $v_i = u_i/E(Y_i)$, it can be seen that $E(v_i^2) = \sigma^2$; that is, the disturbances v_i are homoscedastic. Hence, it is regression (11.6.10) that will satisfy the homoscedasticity assumption of the classical linear regression model.

The transformation (11.6.10) is, however, inoperational because $E(Y_i)$ depends on β_1 and β_2, which are unknown. Of course, we know $\hat{Y}_i = \hat{\beta}_1 + \hat{\beta}_2 X_i$, which is an estimator of $E(Y_i)$. Therefore, we may proceed in two steps: First, we run the usual OLS regression, disregarding the heteroscedasticity problem, and obtain $\hat{Y}_i$. Then, using the estimated $\hat{Y}_i$, we transform our model as follows:

$$\frac{Y_i}{\hat{Y}_i} = \beta_1 \left(\frac{1}{\hat{Y}_i}\right) + \beta_2 \left(\frac{X_i}{\hat{Y}_i}\right) + v_i \tag{11.6.11}$$

where $v_i = (u_i/\hat{Y}_i)$. In Step 2, we run the regression (11.6.11). Although $\hat{Y}_i$ are not exactly $E(Y_i)$, they are consistent estimators; that is, as the sample size increases indefinitely, they converge to true $E(Y_i)$. Hence, the transformation (11.6.11) will perform satisfactorily in practice if the sample size is reasonably large.

Assumption 4: A log transformation such as

$$\ln Y_i = \beta_1 + \beta_2 \ln X_i + u_i \tag{11.6.12}$$

very often reduces heteroscedasticity when compared with the regression $Y_i = \beta_1 + \beta_2 X_i + u_i$.

This result arises because log transformation compresses the scales in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference. Thus, the number 80 is 10 times the number 8, but $\ln 80 (= 4.3280)$ is about twice as large as $\ln 8 (= 2.0794)$.

An additional advantage of the log transformation is that the slope coefficient β_2 measures the elasticity of Y with respect to X, that is, the percentage change in Y for a percentage change in X. For example, if Y is consumption and X is income, β_2 in (11.6.12) will measure income elasticity, whereas in the original model β_2 measures only the rate of change of mean consumption for a unit change in income. It is one reason why the log models are quite popular in empirical econometrics. (For some of the problems associated with log transformation, see exercise 11.4.)

To conclude our discussion of the remedial measures, we reemphasize that all the transformations discussed previously are ad hoc; we are essentially speculating about the nature of σ_i^2. Which of the transformations discussed previously will work will depend on the nature of the problem and the severity of heteroscedasticity. There are some additional problems with the transformations we have considered that should be borne in mind:

1. When we go beyond the two-variable model we may not know a priori which of the X variables should be chosen for transforming the data.[32]
2. Log transformation as discussed in Assumption 4 is not applicable if some of the Y and X values are zero or negative.[33]
3. Then there is the problem of **spurious correlation**. This term, due to Karl Pearson, refers to the situation where correlation is found to be present between the ratios of variables even though the original variables are uncorrelated or random.[34] Thus, in the model $Y_i = \beta_1 + \beta_2 X_i + u_i$, Y and X may not be correlated but in the transformed model $Y_i/X_i = \beta_1(1/X_i) + \beta_2$, Y_i/X_i and $1/X_i$ are often found to be correlated.
4. When σ_i^2 are not directly known and are estimated from one or more of the transformations that we have discussed earlier, all our testing procedures using the t tests, F tests, etc. are strictly speaking valid only in large samples. Therefore, one has to be careful in interpreting the results based on the various transformations in small or finite samples.[35]

11.7 A CONCLUDING EXAMPLE

In concluding our discussion of heteroscedasticity we present an example illustrating various methods of detecting it and some of the remedial measures.

Example 11.8: R&D Expenditure in the United States, 1988. Data on research and development (R&D) expenditures for 18 industry groups in relation to sales and profits are reproduced in Table 11.5. Since the cross-sectional data presented in Table 11.5 are quite heterogeneous, in a regression of R&D on sales (or profits) heteroscedasticity is likely. The results of regressing R&D on sales were as follows:

$$\begin{aligned} \widehat{\text{R\&D}}_i &= 192.99 \quad + 0.0319\ \text{Sales}_i \\ \text{se} &= (990.99) \quad (0.0083) \\ t &= (0.1948) \quad (3.8434) \qquad r^2 = 0.4783 \end{aligned} \tag{11.7.1}$$

As expected, R&D expenditure and sales are positively correlated. The computed t value "seems" to be statistically significant at the 0.002 level (two-tail

[32] However, as a practical matter, one may plot $\hat{u}_i^2$ against each variable and decide which X variable may be used for transforming the data. (See Fig. 11.8.)

[33] Sometimes we can use $\ln(Y_i + k)$ or $\ln(X_i + k)$, where k is a positive number chosen in such a way that all the values of Y and X become positive. See exercise 11.22.

[34] For example, if X_1, X_2, and X_3 are mutually uncorrelated $r_{12} = r_{13} = r_{23} = 0$ and we find that the (values of the) ratios X_1/X_3 and X_2/X_3 are correlated, then there is spurious correlation. "More generally, correlation may be described as spurious if it is induced by the method of handling the data and is not present in the original material." M. G. Kendall and W. R. Buckland, *A Dictionary of Statistical Terms*, Hafner Publishing, New York, 1972, p. 143.

[35] For further details, see George G. Judge et al., op. cit., Sec. 14.4, pp. 415–420.

TABLE 11.5
Innovation in America: Research and development (R&D) expenditure in the United States, 1988 (all figures in millions of dollars)

Industry grouping	Sales	R&D expenses	Profits
1. Containers and packaging	6,375.3	62.5	185.1
2. Nonbank financial	11,626.4	92.9	1,569.5
3. Service industries	14,655.1	178.3	276.8
4. Metals and mining	21,869.2	258.4	2,828.1
5. Housing and construction	26,408.3	494.7	225.9
6. General manufacturing	32,405.6	1,083.0	3,751.9
7. Leisure time industries	35,107.7	1,620.6	2,884.1
8. Paper and forest products	40,295.4	421.7	4,645.7
9. Food	70,761.6	509.2	5,036.4
10. Health care	80,552.8	6,620.1	13,869.9
11. Aerospace	95,294.0	3,918.6	4,487.8
12. Consumer products	101,314.1	1,595.3	10,278.9
13. Electrical and electronics	116,141.3	6,107.5	8,787.3
14. Chemicals	122,315.7	4,454.1	16,438.8
15. Conglomerates	141,649.9	3,163.8	9,761.4
16. Office equipment and computers	175,025.8	13,210.7	19,774.5
17. Fuel	230,614.5	1,703.8	22,626.6
18. Automotive	293,543.0	9,528.2	18,415.4

Note: The industries are listed in increasing order of sales volume.

Source: Business Week, Special 1989 Bonus Issue, R&D Scorecard, pp. 180–224.

test). Of course, if there is heteroscedasticity, we cannot trust the estimated standard errors or the estimated t values. Applying the Park test on the estimated residuals from (11.7.1), we obtain the following results:

$$\begin{aligned} \widehat{\ln \hat{u}_i^2} &= 5.6877 + 0.7014 \ln \text{Sales}_i \\ \text{se} &= (6.6877) \quad (0.6033) \\ t &= (0.8572) \quad (1.1626) \qquad r^2 = 0.0779 \end{aligned} \tag{11.7.2}$$

On the basis of the Park test, we have no reason to reject the assumption of homoscedasticity.

On the basis of the Glejser test, we obtain the following results (to save space, we only present the t values):

$$\begin{aligned} |\hat{u}_i| &= 578.57 + 0.0119\,\text{Sales}_i \\ t &= (0.8525)(2.0931) \qquad r^2 = 0.2150 \end{aligned} \tag{11.7.3}$$

$$\begin{aligned} |\hat{u}_i| &= -507.02 + 7.9270\sqrt{\text{Sales}_i} \\ t &= (-0.5032)(2.3704) \qquad r^2 = 0.2599 \end{aligned} \tag{11.7.4}$$

$$\begin{aligned} |\hat{u}_i| &= 2{,}273.7 + 19{,}925{,}000(1/\text{Sales}_i) \\ t &= (3.7601)(-1.6175) \qquad r^2 = 0.1405 \end{aligned} \tag{11.7.5}$$

As Eq. (11.7.3) and (11.7.4) suggest, the assumption of homoscedastic variances can be rejected. Therefore, the estimated standard errors and t values cannot be accepted at their face value. In exercise 11.23 the reader is asked to apply the Breusch-Pagan and White tests of heteroscedasticity to the data given in Table 11.5.

Since there seems to be doubt about the homoscedasticity assumption, let us see if we can transform the data so as to reduce the severity of heteroscedasticity, if not totally get rid of it. Plotting the residuals obtained from regression (11.7.1), we can see that the error variance is proportional to the sales variable (check this) and hence, following Assumption 2 discussed earlier, we can use the square root transformation, which gives the following results:

$$
\begin{aligned}
\frac{\text{R\&D}_i}{\sqrt{\text{Sales}_i}} &= -246.68\frac{1}{\sqrt{\text{Sales}_i}} + 0.0368\sqrt{\text{Sales}_i} \\
\text{se} &= \quad (341.13) \qquad\qquad (0.0071) \qquad\qquad\qquad\qquad (11.7.6) \\
t &= \quad (-0.6472) \qquad\quad (5.1723) \qquad\qquad R^2 = 0.6258
\end{aligned}
$$

If you multiply (11.7.6) by $\sqrt{\text{Sales}_i}$ on both sides, you will get results comparable to the original regression (11.7.1). There is very little difference in the two slope coefficients. But note that compared to (11.7.1) the standard error of the slope coefficient in (11.7.6) is smaller, suggesting that the (original) OLS regression actually overestimated the standard error. As noted before, in the presence of heteroscedasticity, OLS estimators of standard errors are biased and one cannot foretell which way the bias will go. In the present example the bias is upward, that is, it *overestimated* the standard error. Incidentally, note that (11.7.6) represents *weighted least squares* (why?).

In exercise 11.25 the reader is asked to obtain White's heteroscedasticity-corrected standard errors for the preceding example and compare the results with those given in (11.7.6).

11.8 SUMMARY AND CONCLUSIONS

1. A critical assumption of the classical linear regression model is that the disturbances u_i have all the same variance, σ^2. If this assumption is not satisfied, there is heteroscedasticity.
2. Heteroscedasticity does not destroy the unbiasedness and consistency properties of OLS estimators.
3. But these estimators are no longer minimum variance or efficient. That is, they are not BLUE.
4. The BLUE estimators are provided by the method of weighted least squares, provided the heteroscedastic error variances, σ_i^2, are known.
5. In the presence of heteroscedasticity, the variances of OLS estimators are not provided by the usual OLS formulas. But if we persist in using the usual OLS formulas, the t and F tests based on them can be highly misleading, resulting in erroneous conclusions.
6. Documenting the consequences of heteroscedasticity is easier than detecting it. There are several diagnostic tests available, but one cannot tell for sure which will work in a given situation.
7. Even if heteroscedasticity is suspected and detected, it is not easy to correct the problem. If the sample is large, one can obtain White's heteroscedasticity-corrected standard errors of OLS estimators and conduct statistical inference based on these standard errors.
8. Otherwise, based on OLS residuals, one can make educated guesses of the likely pattern of heteroscedasticity and transform the original data in such a way that in the transformed data there is no heteroscedasticity.

9. Finally, the OLS residuals disturbances not only may be heteroscedastic but also can be autocorrelated. A technique called **autoregressive conditional heteroscedasticity, ARCH** for short, can be employed to attack this problem. We will deal with it in Chapter 12, where we consider the topic of autocorrelation in depth.

EXERCISES

Questions

11.1. State *with brief reason* whether the following statements are true, false, or uncertain:

(*a*) In the presence of heteroscedasticity OLS estimators are biased as well as inefficient.

(*b*) If heteroscedasticity is present, the conventional t and F tests are invalid.

(*c*) In the presence of heteroscedasticity the usual OLS method always overestimates the standard errors of estimators.

(*d*) If residuals estimated from an OLS regression exhibit a systematic pattern, it means heteroscedasticity is present in the data.

(*e*) There is no general test of heteroscedasticity that is free of any assumption about which variable the error term is correlated with.

(*f*) If a regression model is mis-specified (e.g., an important variable is omitted), the OLS residuals will show a distinct pattern.

(*g*) If a regressor that has nonconstant variance is (incorrectly) omitted from a model, the (OLS) residuals will be heteroscedastic.

11.2. In a regression of average wages (W) on the number of employees (N) for a random sample of 30 firms, the following regression results were obtained:*

$$\widehat{W} = 7.5 + 0.009N$$
$$t = \text{n.a.} \quad (16.10) \qquad R^2 = 0.90 \tag{1}$$

$$\widehat{W/N} = 0.008 + 7.8(1/N)$$
$$t = (14.43) \quad (76.58) \qquad R^2 = 0.99 \tag{2}$$

(*a*) How do you interpret the two regressions?

(*b*) What is the author assuming in going from Eq. (1) to (2)? Was he worried about heteroscedasticity? How do you know?

(*c*) Can you relate the slopes and intercepts of the two models?

(*d*) Can you compare the R^2 values of the two models? Why or why not?

11.3. (*a*) Can you estimate the parameters of the models

$$|\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i} + v_i$$

$$|\hat{u}_i| = \sqrt{\beta_1 + \beta_2 X_i^2} + v_i$$

by the method of ordinary least squares? Why or why not?

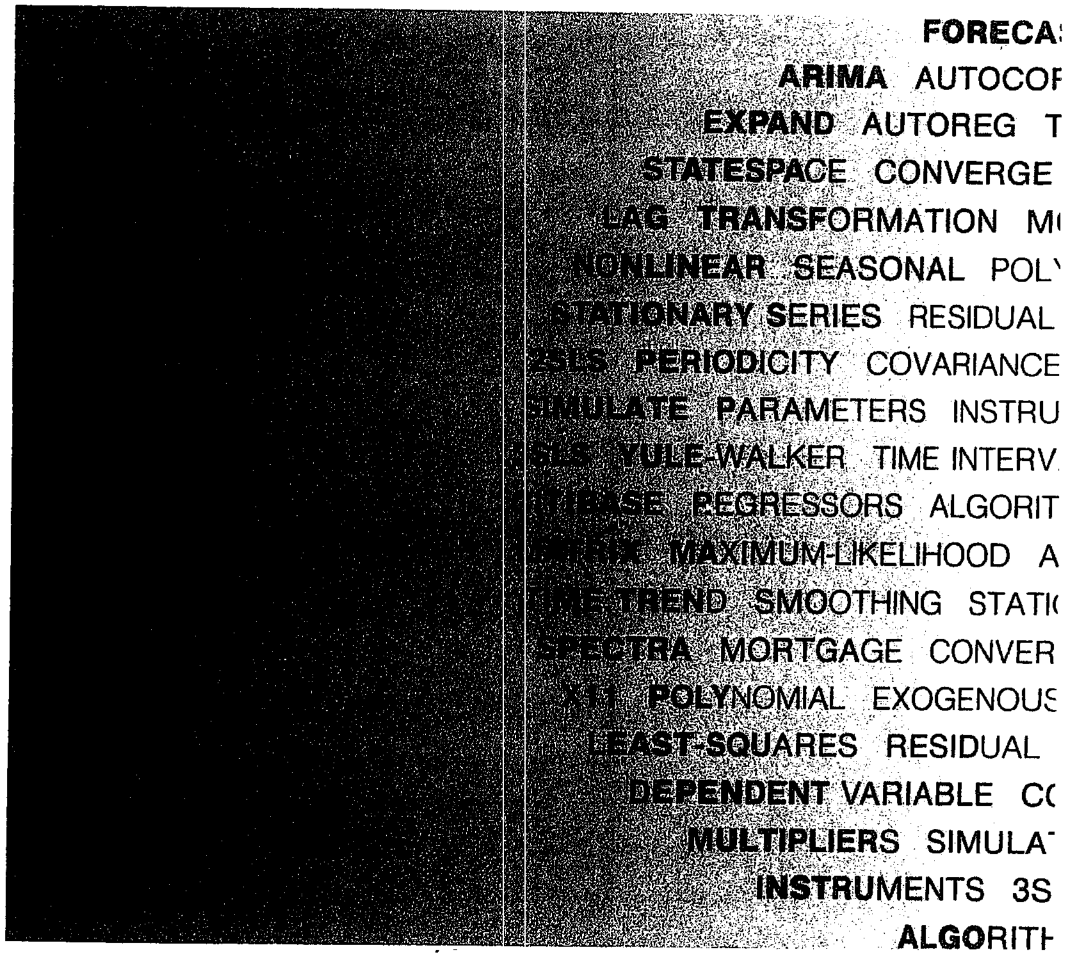
(*b*) If not, can you suggest a method, informal or formal, of estimating the parameters of such models?

*See Dominick Salvatore, *Managerial Economics*, McGraw-Hill, New York, 1989, p. 157.

Attachment 15

SAS/ETS® User's Guide

Version 6
Second Edition



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Subset models are common for seasonal data and often correspond to *factored* autoregressive models. A factored model is the product of simpler autoregressive models. For example, the best model for seasonal monthly data may be the combination of a first-order model for recent effects with a twelfth-order subset model for the seasonality, with a single parameter at lag 12. This results in an order 13 subset model with nonzero parameters at lags 1, 12, and 13. See Chapter 3, "The ARIMA Procedure," for further discussion of subset and factored autoregressive models.

You can specify subset models with the NLAG= option. List the lags to include in the autoregressive model within parentheses. The following statements show an example of specifying the subset model resulting from the combination of a first-order process for recent effects with a fourth-order seasonal process:

```
proc autoreg data=a;
   model y = time / nlag=(1 4 5);
run;
```

The MODEL statement specifies the following fifth-order autoregressive error model:

$$y_t = a + bt + \nu_t$$
$$\nu_t = -\varphi_1 \nu_{t-1} - \varphi_4 \nu_{t-4} - \varphi_5 \nu_{t-5} + \epsilon_t$$

Testing for Heteroscedasticity

One of the key assumptions of the ordinary regression model is that the errors have the same variance throughout the sample. This is also called the *homoscedasticity* model. If the error variance is not constant, the data are said to be *heteroscedastic.*

Since ordinary least-squares regression assumes constant error variance, heteroscedasticity causes the OLS estimates to be inefficient. Models that take into account the changing variance can make more efficient use of the data. Also, heteroscedasticity can make the OLS forecast error variance inaccurate since the predicted forecast variance is based on the average variance instead of the variability at the end of the series.

To illustrate heteroscedastic time series, the following statements re-create the simulated series Y. The variable Y has an error variance that changes from 1 to 4 in the middle part of the series. The length of the series is also extended 120 observations.

```
data a;
   ul = 0; ull = 0;
   do time = -10 to 120;
      s = 1 + (time >= 60 & time < 90);
      u = + 1.3 * ul - .5 * ull + s*rannor(12346);
      y = 10 + .5 * time + u;
      if time > 0 then output;
      ull = ul; ul = u;
      end;
run;

title "Heteroscedastic Autocorrelated Time Series";
```

```
proc gplot data=a;
   symbol1 v=star i=join;
   symbol2 v=none i=r;
   plot y * time = 1 y * time = 2 / overlay;
run;
```

The simulated series is plotted in Figure 4.10.

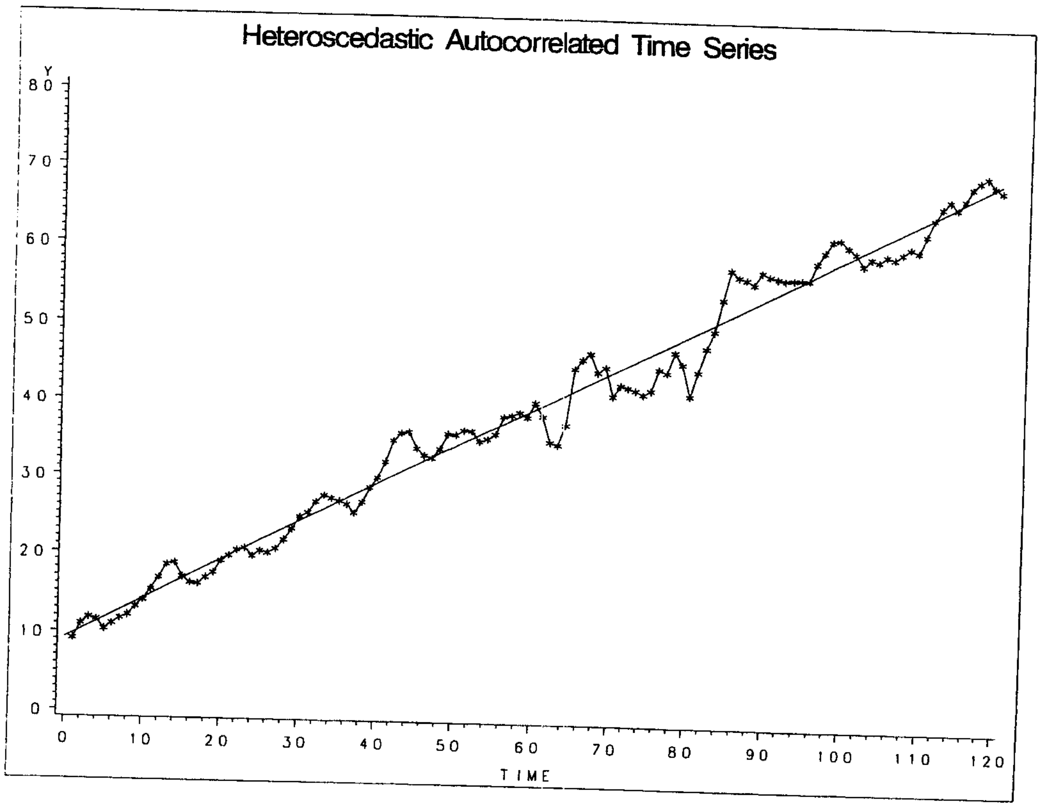


Figure 4.10. Heteroscedastic and Autocorrelated Series

To test for heteroscedasticity with PROC AUTOREG, specify the ARCHTEST option. The following statements regress Y on TIME and use the ARCHTEST option to test for heteroscedastic OLS residuals. The DWPROB option is also used to test for autocorrelation.

```
proc autoreg data=a;
   model y = time / nlag=2 archtest dwprob;
   output out=r r=yresid;
run;
```

The PROC AUTOREG output is shown in Figure 4.11. The Q statistics test for changes in variance across time using lag windows ranging from 1 through 12. (See "Heteroscedasticity and Normality Tests" for details.) The *p*-values for the test statistics are given in parentheses. These tests strongly indicate heteroscedasticity, with p<.0001 for all lag windows.

The Lagrange multiplier (LM) tests also indicate heteroscedasticity. These tests can also help determine the order of the ARCH model appropriate for modeling the heteroscedasticity, assuming that the changing variance follows an autoregressive conditional heteroscedasticity model.

```
                              Autoreg Procedure
Dependent Variable = Y

                     Ordinary Least Squares Estimates

              SSE            690.266     DFE               118
              MSE           5.849712     Root MSE     2.418618
              SBC           560.0705     AIC          554.4955
              Reg Rsq         0.9814     Total Rsq      0.9814
              Durbin-Watson   0.4060     PROB<DW        0.0001

                   Q and LM Tests for ARCH Disturbances

              Order        Q       Prob>Q          LM      Prob>LM

                  1   37.5445      0.0001     37.0072      0.0001
                  2   40.4245      0.0001     40.9189      0.0001
                  3   41.0753      0.0001     42.5032      0.0001
                  4   43.6893      0.0001     43.3822      0.0001
                  5   55.3846      0.0001     48.2511      0.0001
                  6   60.6617      0.0001     49.7799      0.0001
                  7   62.9655      0.0001     52.0126      0.0001
                  8   63.7202      0.0001     52.7083      0.0001
                  9   64.2329      0.0001     53.2393      0.0001
                 10   66.2778      0.0001     53.2407      0.0001
                 11   68.1923      0.0001     53.5924      0.0001
                 12   69.3725      0.0001     53.7559      0.0001

      Variable      DF        B Value    Std Error    t Ratio Approx Prob

      Intercept      1     9.22171095      0.44435     20.753      0.0001
      TIME           1     0.50242021      0.00637     78.825      0.0001
```

Figure 4.11. Heteroscedasticity Tests

Heteroscedasticity and GARCH Models

There are several approaches to dealing with heteroscedasticity. If the error variance at different times is known, weighted regression is a good method. If, as is usually the case, the error variance is unknown and must be estimated from the data, you can model the changing error variance.

The *generalized autoregressive conditional heteroscedasticity* (GARCH) model is one approach to modeling time series with heteroscedastic errors. The GARCH regression model with autoregressive errors is

$$y_t = \mathbf{x}_t'\beta + \nu_t$$
$$\nu_t = \epsilon_t - \varphi_1\nu_{t-1} - \dots - \varphi_m\nu_{t-m}$$
$$\epsilon_t = \sqrt{h_t}\, e_t$$
$$h_t = \omega + \sum_{i=1}^{q}\alpha_i\epsilon_{t-i}^2 + \sum_{j=1}^{p}\gamma_j h_{t-j}$$
$$e_t \sim \mathrm{IN}(0,1)$$

This model combines the mth-order autoregressive error model with the GARCH(p,q) variance model. It is denoted as the AR(m)-GARCH(p,q) regression model.

The Lagrange multiplier (LM) tests shown in Figure 4.11 can help determine the order of the ARCH model appropriate for the data. The tests are significant ($p < .0001$) through order 12, which indicates that a very high-order ARCH model is needed to model the heteroscedasticity.

The basic ARCH(q) model ($p = 0$) is a *short memory* process in that only the most recent q squared residuals are used to estimate the changing variance. The GARCH model ($p > 0$) allows *long memory* processes, which use all the past squared residuals to estimate the current variance. The LM tests in Figure 4.11 suggest the use of the GARCH model ($p > 0$) instead of the ARCH model.

The GARCH(p,q) model is specified with the GARCH=(P=p,Q=q) option in the MODEL statement. The basic ARCH(q) model is the same as the GARCH(0,q) model and is specified with the GARCH=(Q=q) option.

The following statements fit an AR(2)-GARCH(1,1) model for the Y series regressed on TIME. The GARCH=(P=1,Q=1) option specifies the GARCH(1,1) conditional variance model. The NLAG=2 option specifies the AR(2) error process. Only the maximum likelihood method is supported for GARCH models; therefore, the METHOD= option is not needed. The CEV= option in the OUTPUT statement stores the estimated conditional error variance at each time period in the variable VHAT in an output data set named OUT.

```
proc autoreg data=a;
   model y = time / nlag=2 garch=(q=1,p=1) maxit=50;
   output out=out cev=vhat;
run;
```

The results for the GARCH model are shown in Figure 4.12. (The preliminary estimates are not shown.)

```
                         Autoreg Procedure

                          GARCH Estimates

           SSE                218.8459    OBS                 120
           MSE                1.823716    UVAR            1.82567
           Log L              -187.452    Total Rsq        0.9941
           SBC                408.4156    AIC            388.9032
           Normality Test       0.0878    Prob>Chi-Sq      0.9570

Variable       DF         B Value    Std Error    t Ratio Approx Prob

Intercept       1      8.92855101      0.51862     17.216      0.0001
TIME            1      0.50747825      0.00869     58.391      0.0001
A(1)            1     -1.22986252      0.08732    -14.084      0.0001
A(2)            1      0.50204655      0.08959      5.604      0.0001
ARCH0           1      0.08337304      0.06696      1.245      0.2131
ARCH1           1      0.21711705      0.07699      2.820      0.0048
GARCH1          1      0.73721587      0.08772      8.405      0.0001
```

Figure 4.12. AR(2)-GARCH(1,1) Model

The normality test is not significant ($p = .957$), which is consistent with the hypothesis that the residuals from the GARCH model, $\epsilon_t / \sqrt{h_t}$, are normally distributed. The parameter estimates table includes rows for the GARCH parameters. ARCH0 represents the estimate for the parameter ω, ARCH1 represents α_1, and GARCH1 represents γ_1.

The following statements transform the estimated conditional error variance series VHAT to the estimated standard deviation series SHAT. Then, they plot SHAT together with the true standard deviation S used to generate the simulated data.

```
data out;
   set out;
   shat = sqrt( vhat );
run;

title "Predicted and Actual Standard Deviations";
proc gplot data=out;
   plot s*time=1 shat*time=2 / overlay;
   symbol1 v=star i=none;
   symbol2 v=none i = join;
run;
```

The plot is shown in Figure 4.13.

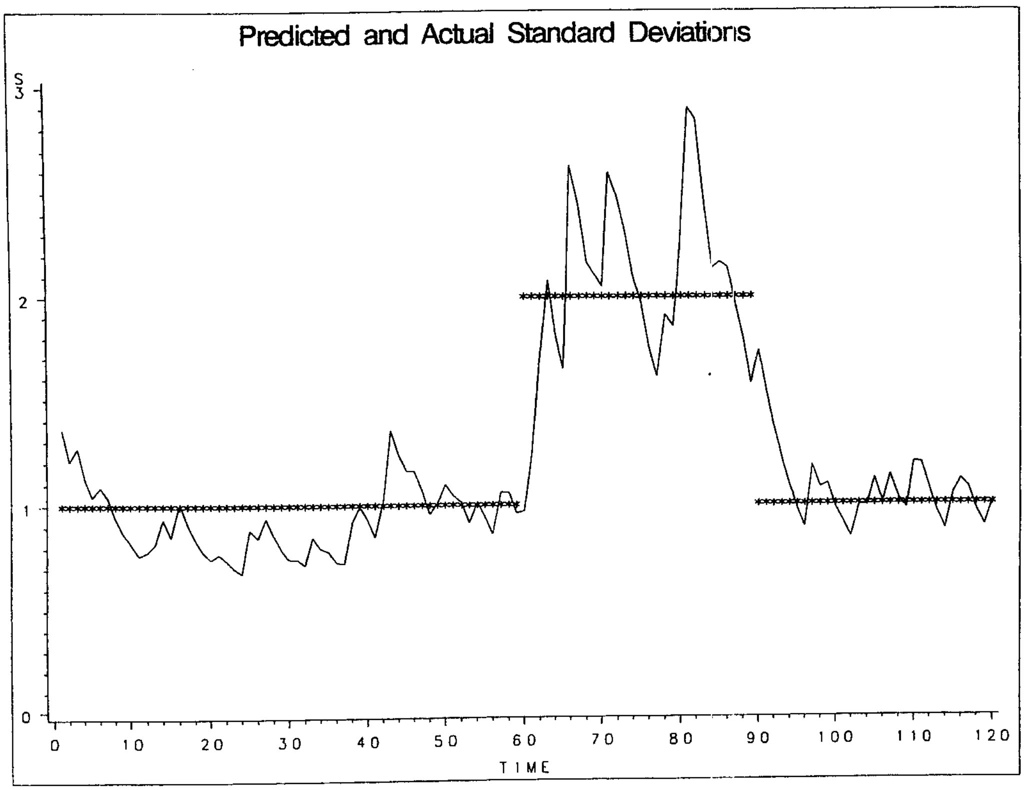


Figure 4.13. Estimated and Actual Error Standard Deviation Series

Note that in this example the form of heteroscedasticity used in generating the simulated series Y does not fit the GARCH model. The GARCH model assumes *conditional* heteroscedasticity, with homoscedastic unconditional error variance. That is, the GARCH model assumes that the changes in variance are a function of the realizations of preceding errors and that these changes represent temporary and random departures from a constant unconditional variance. The data generating process used to simulate series Y, contrary to the GARCH model, has exogenous unconditional heteroscedasticity that is independent of past errors.

Nonetheless, as shown in Figure 4.13, the GARCH model does a reasonably good job of approximating the error variance in this example, and some improvement in the efficiency of the estimator of the regression parameters can be expected.

The GARCH model may perform better in cases where theory suggests that the data generating process produces true autoregressive conditional heteroscedasticity. This is the case in some economic theories of asset returns, and GARCH-type models are often used for analysis of financial markets data.

EGARCH, IGARCH, GARCH-M Models

The AUTOREG procedure supports several variations of the generalized conditional heteroscedasticity model.

Using the TYPE= suboption of the GARCH= option, you can control the constraints placed on the estimated GARCH parameters. You can specify unconstrained, non-negativity constrained (default), stationarity constrained, or integration constrained. The integration constraint produces the integrated GARCH or IGARCH model.

You can also use the TYPE= option to specify the exponential form of the GARCH model, called the EGARCH model. The MEAN suboption of the GARCH= option specifies the GARCH-in-mean or GARCH-M model.

The following statements illustrate the use of the TYPE= option to fit an AR(2)-EGARCH(1,1) model to the series Y. (Output is not shown.)

```
proc autoreg data=a;
   model y = time / nlag=2 garch=(p=1,q=1,type=exp);
run;
```

See the section "GARCH, IGARCH, EGARCH, and GARCH-M Models" later in this chapter for details.

Syntax

The AUTOREG procedure is controlled by the following statements:

PROC AUTOREG *options* ;
   BY *variables* ;
   MODEL *dependent = regressors / options* ;
   OUTPUT OUT = *SAS data set options* ;

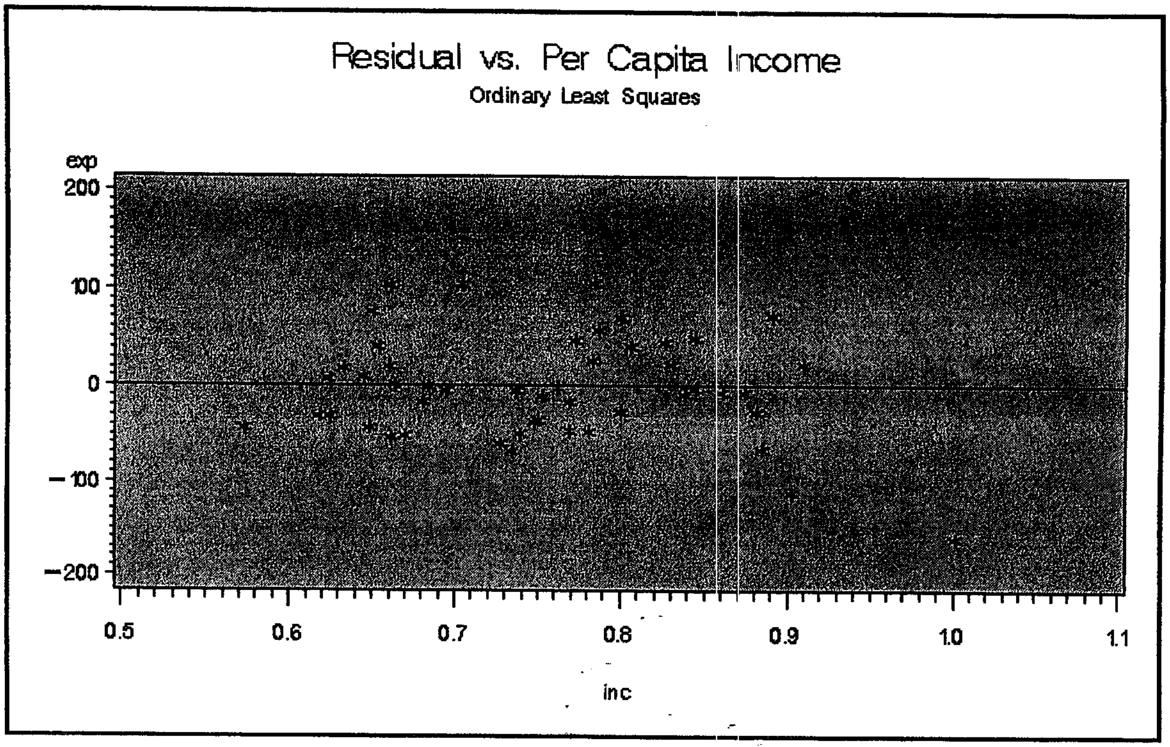
At least one MODEL statement must be specified. One OUTPUT statement can follow each MODEL statement.

Examples

A Simple Regression Model with Correction of Heteroscedasticity

Contents | SAS Program

Overview



One of the classical assumptions of the ordinary regression model is that the disturbance variance is constant, or homogeneous, across observations. If this assumption is violated, the errors are said to be "heteroscedastic." Heteroscedasticity often arises in the analysis of cross-sectional data. For example, in analyzing public school spending, certain states may have greater variation in expenditure than others. If heteroscedasticity is present and a regression of spending on per capita income by state and its square is computed, the parameter estimates are still consistent but they are no longer efficient. Thus, inferences from the standard errors are likely to be misleading.

Testing for Heteroscedasticity

There are several methods of testing for the presence of heteroscedasticity. The most commonly used is the Time-Honored Method of Inspection (THMI). This test involves looking for patterns in a plot of the residuals from a regression. Two more formal tests are White's General test (White 1980) and the Breusch-Pagan test (Breusch and Pagan 1979).

The White test is computed by finding nR^2 from a regression of e_i^2 on all of the distinct variables in $X \otimes X$, where X is the vector of dependent variables including a constant. This statistic is asymptotically distributed as chi-square with k-1 degrees of freedom, where k is the number of regressors, excluding the constant term.

The Breusch-Pagan test is a Lagrange multiplier test of the hypothesis that the independent variables have no explanatory power on the e_i^2's. If u equals ($e_1^2, e_2^2, \ldots, e_n^2$), i equals an n ×1 column of ones, and $\bar{u} = e'e/n$, then Koenkar and Bassett's (1982) robust variance estimator

$$V = \frac{1}{n}\sum_{i=1}^{n}\left(2e_i - \frac{e'e}{n}\right)^2$$

computes the test statistic as

$$LM = \left(\frac{1}{V}\right)(u - \hat{u}\mathrm{i})'Z(Z'Z)^{-1}Z'(u - \hat{u}\mathrm{i})$$

which is asymptotically distributed as chi-square with degrees of freedom equal to the number of variables in Z.

Correcting for Heteroscedasticity

One way to correct for heteroscedasticity is to compute the weighted least squares (WLS) estimator using an hypothesized specification for the variance. Often this specification is one of the regressors or its square.

This example uses the MODEL procedure to perform the preceding tests and the WLS correction in an investigation of public school spending in the United States.

Analysis

If y is public school spending and x is per capita income, and assuming that the variance of the error term is proportional to x_i^2, then the regression model in this example can be written as

$$y_i = \beta x_i + \gamma x_i^2 + \epsilon_i$$

Examples

Estimating GARCH Models

Contents | SAS Program

Overview

The generalized autoregressive conditional heteroscedasticity (GARCH) model of Bollerslev (1986) is an important type of time series model for heteroscedastic data. It explicitly models a time-varying conditional variance as a linear function of past squared residuals and of its past values. The GARCH process has been widely used to model economic and financial time-series data.

Many extensions of the simple GARCH model have been developed in the literature. This example illustrates estimation of variants of GARCH models using the AUTOREG and MODEL procedures, which include the

- Simple GARCH model with normally distributed residuals
- GARCH model with *t*-distributed residuals
- GARCH model with Cauchy-distributed residuals
- GARCH model with generalized error distribution (GED) residuals
- GARCH-in-mean (GARCH-M) model
- Exponential GARCH (EGARCH) model
- Quadratic GARCH (QGARCH) model
- Glosten-Jagannathan-Runkle GARCH (GJR-GARCH) model
- Threshold GARCH (TGARCH) model

Please note that parameter restrictions implied in the GARCH type models are not discussed in this example. If estimated parameters do not satisfy the desired restrictions in a specific model, the BOUNDS or RESTRICT statement can be used to explicitly impose the restrictions in PROC MODEL.

For other examples of GARCH type models, see "Heteroscedastic Modeling of the Federal Funds Rate."

Details

The data used in this example are generated with the SAS DATA step. The following code generates a simple GARCH model with normally distributed residuals.

```
%let df = 7.5;
%let sig1 = 1;
%let sig2 = 0.1 ;
%let var2 = 2.5;
%let nobs = 1000 ;
%let nobs2 = 2000 ;
%let arch0 = 0.1 ;
```

```
%let arch1 = 0.2 ;
%let garch1 = 0.75 ;
%let intercept = 0.5 ;

data normal;
   lu = &var2;
   lh = &var2;

   do i= -500  to &nobs ;
         /* GARCH(1,1) with normally distributed residuals */
      h = &arch0 + &arch1*lu**2 + &garch1*lh;
      u = sqrt(h) * rannor(12345) ;
      y = &intercept + u;
      lu = u;
      lh = h;
      if i > 0 then output;
   end;
run;
```

See the SAS program for more code that generates other types of GARCH models.

Simple GARCH Model with Normally Distributed Residuals

The simple GARCH(p,q) model can be expressed as follows.

Let

$$y_t = x_t\beta + u_t$$

The residual γ is modeled as

$$u_t = \sqrt{h_t} \cdot v_t$$

where v_t is i.i.d. with zero mean and unit variance, and where h_t is expressed as

$$\begin{aligned} h_t &= \kappa + \delta_1 h_{t-1} + \delta_2 h_{t-2} + \cdots + \delta_p h_{t-p} + \\ &\quad \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + \cdots + \alpha_q u_{t-q}^2 \end{aligned}$$

In a standard GARCH model, v_t is normally distributed. Alternative models can be specified by assuming different distributions for v_t, for example, the t distribution, Cauchy distribution, etc.

To estimate a simple GARCH model, you can use the AUTOREG procedure. You use the GARCH= option to specify the GARCH model, and the (P= , Q=) suboption to specify the orders of the GARCH model.

```
proc autoreg data = normal ;
 /* Estimate GARCH(1,1) with normally distributed residuals with AUTOREG*/
   model y = / garch = ( q=1,p=1 ) ;
run ;
quit ;
```

The AUTOREG procedure produces the following output.

The AUTOREG Procedure

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	0.4783	0.0659	6.55	<.0001

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	0.4793	0.0323	14.86	<.0001
[illegible]	1	0.1159	0.0317	3.66	0.0003
[illegible]	1	0.2487	0.0389	6.35	<.0001
[illegible]	1	0.6972	0.0435	16.02	<.0001

You can also use the MODEL procedure to estimate a simple GARCH model. You must first specify the parameters in the model. Then specify the mean model and the variance model. The XLAG function returns the lag of the first argument if it is nonmissing. If the lag of the first argument is missing then the second argument is returned. The XLAG function makes it easy to specify the lag initialization for a GARCH process. The mse.y variable contains the value of the mean squared error for y at each iteration. These values are obtained automatically from first stage estimates, and are used to specify lagged values in estimation.

```
 /* Estimate GARCH(1,1) with normally distributed residuals with MODEL*/
proc model data = normal ;
    parms arch0 .1 arch1 .2 garch1 .75 ;
    /* mean model */
    y = intercept ;
    /* variance model */
    h.y = arch0 + arch1*xlag(resid.y**2,mse.y) +
          garch1*xlag(h.y,mse.y) ;
    /* fit the model */
    fit y / method = marquardt fiml ;
run ;
quit ;
```

The MODEL procedure produces the following output.

The MODEL Procedure

[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.11524	0.0345	3.34	0.0009
[illegible]	0.246808	0.0432	5.72	<.0001
[illegible]	0.697991	0.0494	14.14	<.0001
[illegible]	0.479342	0.0319	15.02	<.0001

Attachment 16

```
NOTE: Copyright (c) 1999-2001 by SAS Institute Inc., Cary, NC, USA.
NOTE: SAS (r) Proprietary Software Release 8.2 (TS2M0)
      Licensed to CAPITAL TRADE, INC., Site 0026331001.
NOTE: This session is executing on the WIN_PRO  platform.



NOTE: SAS initialization used:
      real time           4.07 seconds
      cpu time            0.43 seconds

     /*  WAGE.SAS */
     LIBNAME WAGE 'C:\MY DOCUMENTS\CHINAWAGE';
NOTE: Libref WAGE was successfully assigned as follows:
      Engine:        V8
      Physical Name: C:\MY DOCUMENTS\CHINAWAGE
     OPTIONS LS=150 PS=50 PAGENO=1;
     TITLE 'NME WAGE RATE ANALYSIS';
     DATA WAGE.WAGGNI;
       SET WAGE.wg03all;

     RUN;

NOTE: There were 75 observations read from the data set WAGE.WG03ALL.
NOTE: The data set WAGE.WAGGNI has 75 observations and 2 variables.
NOTE: DATA statement used:
      real time           0.25 seconds
      cpu time            0.01 seconds



     PROC AUTOREG DATA=WAGE.WAGGNI;
         MODEL WAGE = GNI / archtest;
     OUTPUT OUT=REG1;


NOTE: The data set WORK.REG1 has 75 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.35 seconds
      cpu time            0.06 seconds


     PROC AUTOREG DATA=WAGE.WAGGNI;
         MODEL WAGE = GNI/ garch=(q=1,p=1);
     OUTPUT OUT=REG1G;

     Run;

NOTE: The data set WORK.REG1G has 75 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.15 seconds
      cpu time            0.03 seconds
```

LOG of SAS Program -- All 75 Countries for 2003

Test for heteroscedasticity

GLS Code

The AUTOREG Procedure

Dependent Variable wage

Ordinary Least Squares Estimates

SSE	580.072378	DFE	73
MSE	7.94620	Root MSE	2.81890
SBC	374.900614	AIC	370.265638
Regress R-Square	0.8355	Total R-Square	0.8355
Durbin-Watson	2.0650		

Q and LM Tests for ARCH Disturbances

Order	Q	Pr > Q	LM	Pr > LM
1	0.2309	0.6309	0.2136	0.6439
2	0.5997	0.7409	0.5711	0.7516
3	0.6324	0.8890	0.6184	0.8922
4	0.7659	0.9430	0.7649	0.9431
5	1.1639	0.9483	1.1622	0.9485
6	1.2114	0.9763	1.2414	0.9748
7	1.5429	0.9808	1.4695	0.9833
8	1.6273	0.9904	1.5150	0.9925
9	2.1342	0.9892	1.8743	0.9933
10	6.2037	0.7979	5.2328	0.8751
11	6.4550	0.8413	5.2940	0.9161
12	6.6398	0.8805	5.3006	0.9472

Heteroscedasticity test results

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.2101	0.4449	0.47	0.6381
gni	1	0.000508	0.0000264	19.26	<.0001

The AUTOREG Procedure

Results -- 75 Countries

Dependent Variable wage

Ordinary Least Squares Estimates - OLS

SSE	580.072378	DFE	73
MSE	7.94620	Root MSE	2.81890
SBC	374.900614	AIC	370.265638
Regress R-Square	0.8355	Total R-Square	0.8355
Durbin-Watson	2.0650		

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.2101	0.4449	0.47	0.6381
gni	1	0.000508	0.0000264	19.26	<.0001

OLS Estimates

Algorithm converged.

GARCH Estimates - GLS

SSE	580.072378	Observations	75
MSE	7.73430	Uncond Var	7.73429768
Log Likelihood	-183.13282	Total R-Square	0.8355
SBC	379.218102	AIC	372.265638
Normality Test	385.4448	Pr > ChiSq	<.0001

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.2101	1.0870	0.19	0.8467
gni	1	0.000508	0.0000341	14.88	<.0001
ARCH0	1	7.7343	0.5534	13.98	<.0001
ARCH1	1	4.529E-23	0.0000164	0.00	1.0000
GARCH1	1	-2.17E-20	4.028E-16	-0.00	1.0000

GLS Estimates

Log of SAS Program -- 52 Countries Used by Commerce

```
/*  WAGE.SAS */
LIBNAME WAGE 'C:\MY DOCUMENTS\CHINAWAGE';
NOTE: Libref WAGE was successfully assigned as follows:
      Engine:        V8
      Physical Name: C:\MY DOCUMENTS\CHINAWAGE
OPTIONS LS=150 PS=50 PAGENO=1;
TITLE 'NME WAGE RATE ANALYSIS';
DATA WAGE.WAGGNI;
  SET WAGE.wg03doc;

RUN;

NOTE: There were 52 observations read from the data set WAGE.WG03DOC.
NOTE: The data set WAGE.WAGGNI has 52 observations and 2 variables.
NOTE: DATA statement used:
      real time           0.04 seconds
      cpu time            0.00 seconds


PROC AUTOREG DATA=WAGE.WAGGNI;
    MODEL WAGE = GNI / archtest;
OUTPUT OUT=REG1;
```

Test for heteroscedasticity

```
NOTE: The data set WORK.REG1 has 52 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.03 seconds
      cpu time            0.03 seconds


PROC AUTOREG DATA=WAGE.WAGGNI;
    MODEL WAGE = GNI/ garch=(q=1,p=1);
OUTPUT OUT=REG1G;
```

GLS Code

```
Run;

NOTE: The data set WORK.REG1G has 52 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.03 seconds
      cpu time            0.03 seconds
```

The AUTOREG Procedure

Dependent Variable wage

Ordinary Least Squares Estimates

SSE	192.133991	DFE	50
MSE	3.84268	Root MSE	1.96028
SBC	223.433457	AIC	219.53097
Regress R-Square	0.9163	Total R-Square	0.9163
Durbin-Watson	2.1625		

Q and LM Tests for ARCH Disturbances

Order	Q	Pr > Q	LM	Pr > LM
1	0.7550	0.3849	0.8614	0.3533
2	1.2268	0.5415	1.3982	0.4970
3	1.2646	0.7376	1.3983	0.7059
4	1.6183	0.8055	1.7188	0.7873
5	2.4812	0.7793	2.1740	0.8246
6	6.1898	0.4023	7.1170	0.3102
7	7.1077	0.4178	7.3085	0.3975
8	7.3661	0.4977	7.3599	0.4983
9	7.4620	0.5891	7.3940	0.5962
10	7.9510	0.6336	7.4816	0.6793
11	9.3051	0.5937	7.4927	0.7579
12	9.7081	0.6416	7.7259	0.8062

Heteroscedasticity test results

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.4108	0.3819	1.08	0.2873
gni	1	0.000515	0.0000220	23.40	<.0001

The AUTOREG Procedure

Results -- 52 Countries

Dependent Variable wage

Ordinary Least Squares Estimates -- OLS

SSE	192.133991	DFE	50
MSE	3.84268	Root MSE	1.96028
SBC	223.433457	AIC	219.53097
Regress R-Square	0.9163	Total R-Square	0.9163
Durbin-Watson	2.1625		

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.4108	0.3819	1.08	0.2873
gni	1	0.000515	0.0000220	23.40	<.0001

OLS Estimates

Algorithm converged.

GARCH Estimates -- GLS

SSE	192.640226	Observations	52
MSE	3.70462	Uncond Var	4.07017542
Log Likelihood	-106.87584	Total R-Square	0.9161
SBC	229.556655	AIC	221.75168
Normality Test	7.8287	Pr > ChiSq	0.0200

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.2722	0.6344	0.43	0.6679
gni	1	0.000520	0.0000241	21.54	<.0001
ARCH0	1	2.8136	0.6949	4.05	<.0001
ARCH1	1	0.3087	0.2954	1.05	0.2960
GARCH1	1	-2.39E-23	4.637E-14	-0.00	1.0000

GLS Estimates

Log of SAS Program -- 26 Low-Income and Lower-Middle-Income Countries

```
/*  WAGE.SAS */
LIBNAME WAGE 'C:\MY DOCUMENTS\CHINAWAGE';
NOTE: Libref WAGE was successfully assigned as follows:
      Engine:        V8
      Physical Name: C:\MY DOCUMENTS\CHINAWAGE
OPTIONS LS=150 PS=50 PAGENO=1;
TITLE 'NME WAGE RATE ANALYSIS';
DATA WAGE.WAGGNI;
  SET WAGE.wg03li;

RUN;

NOTE: There were 26 observations read from the data set WAGE.WG03LI.
NOTE: The data set WAGE.WAGGNI has 26 observations and 2 variables.
NOTE: DATA statement used:
      real time           0.04 seconds
      cpu time            0.00 seconds



PROC AUTOREG DATA=WAGE.WAGGNI;
    MODEL WAGE = GNI / archtest;
OUTPUT OUT=REG1;


NOTE: The data set WORK.REG1 has 26 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.03 seconds
      cpu time            0.03 seconds


PROC AUTOREG DATA=WAGE.WAGGNI;
    MODEL WAGE = GNI/ garch=(q=1,p=1);
OUTPUT OUT=REG1G;

Run;

NOTE: The data set WORK.REG1G has 26 observations and 2 variables.
NOTE: PROCEDURE AUTOREG used:
      real time           0.03 seconds
      cpu time            0.03 seconds
```

The AUTOREG Procedure

Dependent Variable wage

Ordinary Least Squares Estimates

SSE	1.63369255	DFE	24
MSE	0.06807	Root MSE	0.26090
SBC	8.35240009	AIC	5.83620702
Regress R-Square	0.5675	Total R-Square	0.5675
Durbin-Watson	2.3539		

Q and LM Tests for ARCH Disturbances

Order	Q	Pr > Q	LM	Pr > LM
1	0.3125	0.5762	0.3539	0.5519
2	2.9010	0.2345	2.8903	0.2357
3	2.9431	0.4005	3.5317	0.3167
4	8.5532	0.0733	4.9756	0.2898
5	9.2552	0.0993	5.7399	0.3324
6	10.0434	0.1228	5.8263	0.4429
7	10.0526	0.1856	6.7725	0.4529
8	13.1608	0.1064	6.7781	0.5608
9	14.6219	0.1019	8.9496	0.4419
10	16.1109	0.0965	10.2004	0.4231
11	16.1514	0.1356	10.2775	0.5056
12	22.5380	0.0319	11.0938	0.5209

Heteroscedasticity test results.

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.1854	0.1261	1.47	0.1545
gni	1	0.000427	0.0000761	5.61	<.0001

The AUTOREG Procedure

Dependent Variable wage

Results -- 26 Low- and Lower-Middle-Income Countries.

Ordinary Least Squares Estimates -OLS

SSE	1.63369255	DFE	24
MSE	0.06807	Root MSE	0.26090
SBC	8.35240009	AIC	5.83620702
Regress R-Square	0.5675	Total R-Square	0.5675
Durbin-Watson	2.3539		

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.1854	0.1261	1.47	0.1545
gni	1	0.000427	0.0000761	5.61	<.0001

OLS Estimates

Algorithm converged.

GARCH Estimates — GLS

SSE	1.63369255	Observations	26
MSE	0.06283	Uncond Var	0.06283433
Log Likelihood	-0.9181035	Total R-Square	0.5675
SBC	14.8685932	AIC	9.83620702
Normality Test	2.5560	Pr > ChiSq	0.2786

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	0.1854	0.1578	1.18	0.2399
gni	1	0.000427	0.0000832	5.13	<.0001
ARCH0	1	0.0627	0.0247	2.54	0.0110
ARCH1	1	-6.72E-23	1.737E-15	-0.00	1.0000
GARCH1	1	0.002700	0	Infty	<.0001

GLS Estimates

EXHIBIT B

Wage and Per-Capita GNI, Surrogate Countries--Avg. Wage and Results of Regression Analysis, 2003

Country	wages	Per Capita GNI
India	0.23	540
Indonesia	0.41	810
Pakistan	0.38	520
Philippines	0.80	1,080
Sri Lanka	0.34	930
Average	0.43	776

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.746
R Square	0.556
Adjusted R Square	0.408
Standard Error	0.167
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	0.10449257	0.104493	3.755185	0.148026
Residual	3	0.08347863	0.027826		
Total	4	0.1879712			

	Coefficients	*Standard Erro.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*.ower 95.0%*	*Upper 95.0%*
Intercept	-0.0820	0.2753	-0.2979	0.7852	-0.9583	0.7943	-0.9583	0.7943
X Variable 1	0.0007	0.0003	1.9378	0.1480	-0.0004	0.0017	-0.0004	0.0017

China GNI	1100
China Wage	0.65