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MEASURING CORRUPTION FROM HOUSEHOLD INCOME AND CONSUMPTION MICRO-DATA: AN INTERNATIONAL PERSPECTIVE

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ABSTRACT

Measuring Corruption From Household Income and Consumption Micro-Data: An International Perspective

Using household survey data on expenditures and incomes, we construct an objective measure of corruption in the public sector for a broad spectrum of countries. Specifically, we focus on the consumption-income gap for public sector workers relative to private sector workers to gauge the extent of hidden income (bribes) in the government. After validating our data and documenting properties of the consumption-income gap, we compare our measure with popular corruption perception indices. We find that i) the relationship between our measure and the alternatives is nonlinear; ii) available indices appear to be only weakly (and sometimes "wrongly") correlated with the consumption-income gap at high frequencies; iii) the available indices appear to have a low weight on the relative consumption-income gap in the public sector.

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I. Introduction

Few things draw more public ire than corruption. Whether humanity will ever succeed in eradicating this disease remains uncertain, but it is clear that a key part of the problem is the measurement of corruption, an activity that is hidden by its nature. Although much progress has been made in quantifying corruption, there is a growing consensus that existing corruption indices may provide a distorted picture of the actual state of bribery, graft, etc. in a society. Specifically, popular indices of corruption such as the Corruption Perception Index developed by Transparency International is a *perception* index which appears to often disagree with measures of *experienced* corruption.[1] Thus, there is an acute need—sometimes literally a matter of life or death for whole countries[2]—to develop objective, reliable, and timely measures of corruption as well as to validate existing measures to guide public policy and discourse.

This paper aims to contribute to this important effort. In particular, we use household surveys gathering information about incomes and expenditures to construct an objective measure of corruption. Given the wide availability of such surveys in the world, our measure can be constructed for a broad spectrum of countries, including those where reliable data are generally scarce. In a nutshell, we build on the approach developed by Gorodnichenko and Peter (2007) and focus on the difference between self-reported consumer spending and incomes. Intuitively, if a public-sector worker spends more than he or she can afford (relative to a private-sector worker), one can reasonably suspect a hidden source of income (bribes). This aligns with the common practice of fiscal authorities to use discrepancies between income and expenditures to detect tax

[1] Perceptions are often elicited via surveys of experts or the general population. Given the sensitive nature of such survey responses about corruption, it is not unusual to frame questions about "people like you" rather than ask about the respondents themselves. Perceptions can be quite different from what respondents experience themselves. For example, since 2007, USAID has sponsored the Anticorruption Perception and Experience Poll (https://engage.org.ua/stan-koruptsii-v-ukraini-spryjniattia-dosvid-stavlennia) in Ukraine. In 2021, 63% of Ukrainians believed that corruption is widespread in the country and this belief was quite stable (63.8% in 2015 and 65.5% in 2018). At the same time, only 19.4% of Ukrainians in 2021 encountered demands to pay bribes to resolve their issues, which is much lower than 36.8% in 2018. Thus, despite the fact that Ukraine made huge progress in reducing corruption, the perceptions were lagging.

[2] For example, after the Russian full-scale invasion of Ukraine on February 24, 2022, U.S. government aid to Ukraine was withheld on multiple occasions because perception indices apparently convinced U.S. policymakers that Ukraine is an utterly corrupt country. On the other hand, there has been little reliable evidence of international aid delivered since the start of the war being stolen, embezzled, or misused in Ukraine. By contrast, various governments consistently report that Ukraine can account for all military equipment delivered to Ukraine, implying that stories that Ukraine sells these weapons in the black market had no factual basis. Similarly, recent audits of financial aid given to the Ukrainian government have not found evidence of systemic mismanagement, fraud, stealing, etc.

evasion (see e.g. Part 9 of the U.S. Internal Revenue Service Manual).[3] The main advantage of this approach is that it uses existing data (i.e., household surveys which are available in many countries) and thus can be easily scaled, but one needs a "no corruption" benchmark group. Furthermore, the consumption-income gap can also help gauge the magnitude of corruption in a country. We estimate consumption-income gaps over the 1995-2023 period for a diverse set of 57 countries ranging from emerging markets (e.g., Côte d'Ivoire, Iraq, Paraguay) to advanced economies (e.g., Taiwan, Canada, Finland).

After validating our data, we document that popular corruption indices (Corruption Perception Index by Transparency International, Corruption Control Index (World Governance Indicators) by the World Bank, Ethics and Corruption Index by World Economic Forum) do not correlate strongly with the consumption-income gap, which questions the credibility of these indices. Our analysis also suggests that raising salaries of public sector employees does not guarantee a lower level of corruption. Indeed, countries with some of the highest wage premia in the public sector can be some of the most corrupt countries in the world. Of course, this pattern does not imply causation, but it does indicate that reforms to reduce corruption should go well beyond ensuring market wages in the public sector or paying a premium to nourish honesty.[4]

Our work contributes to several strands of research. First, we contribute to the growing literature studying the properties of corruption perception indices. Treisman (2007), Olken (2009), Razafindrakoto and Roubaud (2010), Donchev and Ujhelyi (2014), Delios et al. (2024) and others document that corruption perception indices have various biases. We provide another validation of the perception indices based on the relative consumption-income gap for public-sector workers. More broadly, we support the effort to utilize experience-based data on the impact of (anti-) corruption activities which have more credibility than perception-based data (UNDP 2015).

Second, we contribute to research that aims to utilize objective data to quantify corruption. With some oversimplification (see Fang (2024) for a discussion), one can group methods in existing studies as follows: *i*) direct measurement such as police/conviction records and victimization surveys (e.g., Aidt et al (2020) used the China Corruption Conviction Databank to understand the

[3] https://www.irs.gov/irm/part9.
[4] Efficiency wages in the public sector have been known and used for a long time. For example, "money to nourish honesty" (yang-lien yin) was a bonus paid to magistrates in imperial China to reduce corruption (Bardhan 1997).

profile of corrupted officials), *ii*) data cross checks (e.g., Fisman and Wei (2004) compared Chinese import records with Hong Kong's export records), *iii*) market inference (e.g., Gorodnichenko and Peter (2007) compared consumption-income gaps of Ukrainian private and public sector workers), *iv*) correspondent studies (e.g., Findley et al. (2013) ran a randomized controlled trial to set up shell companies to avoid taxes), *v*) indirect data (e.g., Blavatskyy (2021) used the body mass index of public officials to identify corruption). Most studies in this literature tend to be done for a given country. For example, the relative consumption-income gaps were studied separately in the United Kingdom (Pissarides and Weber 1989), Ukraine (Gorodnichenko and Peter 2007), India (Saha et al. 2014), USA (Hurst et al. 2014), and Estonia (Paulus 2015). We advance this literature by providing the first cross-country analysis within the market inference group.

Third, our work is related to the large literature examining wage premia in the public sector (see Bardhan (1997) and Bender (1998) for early surveys of the literature and discussions of various theories). Early work in this line of research utilized aggregate data to estimate wage premia (e.g., Van Rijckeghem and Weder 2001, Panizza 2001, Le et al. 2013, An and Kweon 2017) and related these premia to the extent of corruption in a country. Generally, the results in this literature suggested that there is no clear relationship between corruption and wage premia in the public sector. More recent work utilizes worker-level data to control for differences in worker characteristics across sectors (e.g., civil servants tend to be more educated than the general workforce in the private sector). For instance, Demirgüç-Kunt et al. (2023) run Mincerian wage regressions to estimate (with OLS) public sector wage premia for many countries. This study finds a *negative* relationship between the wage premia and popular corruption perception indices, but the sign of the relationship is reversed when wage inequality in the public sector is low. Our analysis is methodologically similar, but we use somewhat different datasets that have both incomes and expenditures at the household level. We find that the relationship between wage premia and corruption is non-linear: premia are associated with lower levels of corruption (according to various corruption indices) if countries are already relatively clean but the premia are associated with higher levels of corruption when countries already have corruption issues.

The rest of the paper is structured as follows. Section II explains our approach to measuring corruption from household surveys. Section III describes data sets used in our analysis. Section IV presents the results. Section V provides a discussion and concluding remarks.

II. Method

The approach developed in Gorodnichenko and Peter (2007) relies on three premises. First, when households report consumer expenditure in a household survey, they should not lie about how much they spend on tomatoes, clothing or other common spending items. This is because they do not see how this information can reveal the extent of their possible bribes or other forms of corruption income. At the same time, it is clear that luxury items such as expensive watches, cars, houses, etc. are likely under-reported by corrupted public sector workers because they can immediately raise questions about the sources of income. For similar reasons, households would be unwilling to report their income due to bribery, corruption, etc.

Second, economic theory predicts that consumption should be equal to permanent income. We do not directly observe permanent income, but one may expect that income predicted by a Mincerian regression should be a good proxy for the persistent component of the income. Indeed, factors such as education, age, tenure, gender, etc. vary little over time and hence the predicted income should capture the stable part of a household's income.

Third, if workers are mobile across employers and sectors, one should expect that utility should be equalized across employers and sectors. In other words, in equilibrium, workers should be indifferent between working in the public sector and working in the private sector.

By combining these important insights, we arrive at a simple test (and measure) of corruption: in the absence of corruption, employment in the public sector should not predict (log) ratio of consumption to income. To operationalize this test, we estimate the following regression:

$$\log\left(\frac{C_{it}}{Y_{it}}\right) = \beta \times Public_{it} + \phi \times \boldsymbol{X}_{it} + error \qquad (1)$$

where i and t index households and time, $Public$ is an indicator variable equal to one if a member of household i is employed in the public sector, $\boldsymbol{X}$ is a vector of household and respondent controls (education, age, household size, number of children, rural/urban status, etc.). Variables $\boldsymbol{X}$ can be helpful to control for life-cycle profiles in $\log(C/Y)$.

The coefficient of interest in specification (1) is β. The no-corruption case would be consistent with $\beta = 0$. If $\beta > 0$, households with a public sector employee enjoy a level of consumption that is above their reported income. This case would be consistent with corruption in the public sector. If $\beta < 0$, one may expect that the households employed in the private sector have

income from the shadow economy. Intuitively, public sector workers are employed in the formal sector while the private sector workers can receive income from the informal sector.

Furthermore, one can use β to gauge the size of the shadow economy. Assuming that consumer spending is reported truthfully, we can quantify the volume of the unreported income ("bribes") as $(\exp(\beta) - 1) \times \bar{C}$ where $\bar{C}$ is the average level of consumer spending by households with public-sector employees. For example, Gorodnichenko and Peter (2007) scale this volume by GDP to provide a simple metric of corruption in the Ukrainian economy.

While the assumptions behind this approach are intuitive, the reality is of course more complex and there could be multiple threats to the interpretation of β as a measure of corruption. For example, the public sector can offer greater job security and hence public-sector workers can have lower precautionary savings and higher levels of consumption. Public sector jobs can also offer fringe benefits (subsidized health insurance, generous pensions, etc.) that are not available in the private sector. These and similar factors can result in $\beta > 0$ or $\beta < 0$. With sufficiently detailed information (e.g., a more comprehensive survey coverage of monetary and non-monetary compensation), one can assess the magnitude of these compensating differentials and possibly rule them out as was done by Gorodnichenko and Peter (2007) who used the richness of the Ukrainian Longitudinal Monitoring Survey (ULMS).

Unfortunately, as we discuss below, available data are typically not rich enough to rule out many of the potentially confounding explanations and thus we have to settle with a simpler test. Specifically, we estimate the following Mincerian regression:

$$\log(Y_{it}) = \alpha \times Public_{it} + \psi \times \boldsymbol{X}_{it} + error \qquad (2)$$

To the extent $\alpha \approx 0$, one can argue that public sector workers receive compensation comparable to what they could have earned in the private sector and therefore they should have weaker incentives to take bribes (that is, β should be zero). Note that the role of controls $\boldsymbol{X}$ is potentially more important here because public sector employees likely have higher educational attainment and therefore command higher compensation. Hence, we will focus on the estimates of α and β as measures of compensation and corruption in a country.

While this simple check can go a long way in addressing many concerns, it leaves some important questions open. In particular, Gorodnichenko and Peter (2007) assume that there is no

bribery or other hidden income in the private sector. One may argue that private firms do not have to bribe their employees to perform their duties, but it is less obvious that private firms disclose all wages paid to the employees. For example, if firms and employees agree to make payments in cash to evade taxes, income reported in a household survey may be lower than reported spending (this can yield $\beta < 0$). One can mitigate this concern to some extent by excluding self-employed and agricultural workers where tax evasion and informality may be particularly concerning.[5] This may be a significant hurdle in countries where informal employment is pervasive and law-abiding private employers (e.g., multinational companies or state-owned enterprises) are relatively rare and thus our baseline estimates include the self-employed.[6] We also note that β estimates "average" ("petty") corruption while public discussion may be centered on corruption in the top echelons of the government. While we obviously cannot use our approach to quantify corruption at the level of presidents or cabinet ministers, one can make some progress by using quantile regressions as in Gorodnichenko and Peter (2007). This discussion suggests that, on balance, various confounding factors likely result in an estimated β that is a lower bound for the degree of corruption in the public sector.

III. Data

In this section, we explain how we construct income and spending from household surveys. We also describe sources of survey data and discuss pros and cons of various datasets. Finally, we briefly review the popular corruption perception indices, which provide useful benchmarks for understanding cross-country and time-series variation in estimated α and β.

A. Data sources

Our analysis requires that we have access to household-level data on income *and* expenditure. These data are usually collected by household surveys for various reasons. For example, some surveys (such as the Ukrainian Longitudinal Monitoring Survey or the U.S. Panel Study of Income Dynamics (PSID)) were developed to measure long-term trends in incomes, mobility, inequality, etc. Respondents are often encouraged to consult their tax returns to provide accurate measures of

[5] Pissarides and Weber (1989) and Hurst et al. (2014) use employees as the benchmark to assess tax evasion done by the self-employed in the United Kingdom and the USA.

[6] We generally exclude households which only contain self-employed workers. We also verify in a robustness check that controlling for self-employed individuals within households (which reduces the country-year sample available for analysis) does not change our conclusions.

income. Expenditures in these surveys tend to be collected at a more aggregate level and the coverage can be somewhat limited (e.g., PSID used to collect only expenditure on food and more comprehensive measures of expenditures were introduced relatively recently). Another popular source is household budget surveys that are commonly used to construct weights for various price indices. For instance, the U.S. Consumer Expenditure Survey is run by the U.S. Bureau of Labor Statistics to construct weights for the Consumer Price Index. These surveys tend to have detailed information on consumer spending (e.g., spending on tomatoes, gasoline, phone bills, alimonies, etc.) but income data tend to be coarse.

We note that there are many more sources that collect data on either income or spending but not both. For instance, tax authorities have high-quality, administrative data on incomes but lack information on spending. In a similar vein, the U.S. Current Population Survey has detailed income data (again, respondents are asked to consult their tax returns) but does not collect information on spending. Financial aggregators and credit card companies typically have detailed spending data (whatever is in credit card statements is potentially available to researchers) and income data (direct deposits from employers or the government) but these sources often have very limited information on account holders (e.g., gender, education, etc. as well as the exact employer are often not known). As a result, we cannot use these sources in our analysis.

Table 1 summarizes our sources. As one can see, we cover a large and diverse set of countries ranging from Iraq to Ukraine to Germany. We use surveys that were collected recently as they tend to have higher quality and can be more relevant for current debates on corruption. Two sources of micro-data are particularly helpful as they harmonize data across countries and time. The Luxembourg Income Study Database (LIS) covers 52 countries primarily in Europe, North America, South America, and Asia. This database includes harmonized variables at both the household and individual level. The underlying data are collected from a multitude of surveys, focusing on household income and expenditure surveys within the respective countries as well as harmonized surveys such as EU-SILC. These surveys are generally cross-sectional and panel household surveys which produce annual and/or monthly level data that also contain information on household demographics and employment. LIS also contains the Economic Research Forum (ERF) database which harmonizes household expenditure surveys for countries in the Middle East and Africa (Iraq, Egypt, Jordan, Palestine, Somalia, Sudan, and Tunisia). The LIS database has

information from 1963 to 2023, providing the majority of country-year observations. We also use the Household Budget Survey (HBS) database, a harmonized database provided by Eurostat covering the years 2010, 2015, and 2020 for many European countries. This database includes both household and individual level data similar to LIS, with a larger focus on expenditures. The database consists of household budget surveys created separately within each member country which collect demographic, income, and expenditure information in relation to the agreed upon reference years (the data are mapped to 2010, 2015, and 2020). This database helps to fill in the gaps in the LIS data for Europe and accounts for around 30% of the final country-year group results. We complement these sources with surveys available directly from statistical offices or research institutions. These include longitudinal and cross-sectional household income and expenditure surveys from countries including Indonesia, Argentina, Bolivia, El Salvador, China, and Ukraine. These datasets contain household and individual level information comparable to the databases mentioned above, with harmonization occurring at the country level. The surveys include questions on demographics, employment, incomes, and expenditures at the annual, monthly, weekly, and other frequencies. These data sources account for the remaining portion of the results.

B. Consumption and Income

Spending data are reported at different frequencies (e.g., over previous three months, past week, etc.) and levels of aggregation (e.g., food vs detailed categories of food). Most commonly the aggregate expenditures are reported at annual and monthly frequencies. We harmonize the data so that spending is measured at the annual frequency. We exclude households that report unusually low or high levels of spending and winsorize log expenditures at the bottom and top 1%. We try to use total expenditures created within the survey/database, but some countries have more limited coverage. Expenditures are aggregated across household members and annualized when total measures are unavailable.

Incomes are often reported for each member of the household separately and sometimes at different levels of aggregation (e.g., total vs categories like employment and transfers). We aggregate incomes across household members and compute the annual equivalent. Wherever possible, we use total income measures created within the survey/database. We also prioritize net income measures if the number of observations is not significantly less than the gross income

measures. Again, we exclude households who report unusually low or high incomes and winsorize log incomes at the bottom and top 1%.

We note that spending and income data may have a number of limitations (e.g., we can have spending on food rather than full measures of consumer expenditures). Approximately 50% of the results rely on partial expenditures (e.g., non-durable spending, food), with the majority coming from the LIS database. Only around 5 to 10% of the results contain incomplete incomes. Overall, the HBS and the individually collected survey data are more complete in expenditures when compared to LIS. However, to the extent these limitations apply equally to workers in the public and private sector, α and β continue to be useful indicators of how the behavior of public-sector employees deviate from the behavior of their private sector counterparts.

C. Socioeconomic characteristics

Surveys differ greatly in how much information is collected about respondents or other household members. To ensure consistency across countries and time, we focus on a somewhat limited set of characteristics: maximum educational attainment in a household (indicator variables for each level; the level of detail varies across countries and years), average age in a household (for those above the age of 18), presence of children or the elderly (indicator variables), location (rural vs. urban, indicator variables for regions), number of earners, household size, employment status (indicator variables for full-time employment), and sector of employment (we use this information to construct an indicator variable for the public sector). Public sector households are identified by the existence of household members with occupations that are strictly defined as being within the public sector under the survey/database definition. What is included in the public sector varies across countries. When detailed occupational data are available, we generally try to use the intersection between the public sector defined within the survey/database and public administration and civil servant occupations. However, sometimes the public sector definition can include education and healthcare sectors that employ civil servants. Therefore, our public sector household identification may include these individuals, especially when detailed occupational data

is sparce or unavailable. Individuals working for state-owned enterprises and other government owned organizations are also generally included in the public sector.[7]

D. Corruption Indices

We use three popular corruption indices. The first one is the Corruption Perception Index (CPI) which is constructed and maintained by Transparency International, a non-profit organization. In 2012, Transparency International redesigned the index and changed the scale from 0-10 to 0-100 (zero corresponds to maximum corruption). To utilize the data for the earlier period, we use regressions to rescale and splice the data.[8] Most of the data are derived from other data providers (e.g., African Development Bank, Economist Intelligence Unit) who run their own surveys of experts, households or firms to elicit their subjective perceptions of corruption. The surveys generally refer to the current or previous year. The index focuses on various dimensions of corruption including bribery, diversion of public funds, use of public office for private gain, and state capture. Data are available from 1995 to 2023.

The second index is the Corruption Control Indicator (CCI) constructed by the World Bank for its World Governance Indicators. Similar to CPI, this indicator aims to measure "…the extent to which public power is exercised for private grain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests."[9] This index also relies on data collected by other data providers but some data are collected by the World Bank. This index varies from -2.5 (poor control) to 2.5 (strong control). Data are available for 1996-2023.

The third index is the Ethics and Corruption Index (ECI) constructed by the World Economic Forum (WEF). This index is derived from WEF's Executive Opinion Survey and focuses on three

[7] Ideally, one should distinguish workers in public administration and state-owned enterprises (SOEs). In a nutshell, SOEs compete with private sector counterparts for plumbers, accountants, drivers, IT specialists, etc. but SOEs have to follow legal requirements for reporting income (private firms likely have more leeway to compensate workers via cash payments to avoid taxes). At the same time, relative to public administration employees, SOE workers likely have fewer opportunities to extract bribes because they do not have the same decision-maker power. This is why Gorodnichenko and Peter (2007) distinguish private-sector workers, public administration workers and SOE workers in the ULMS. Unfortunately, most surveys do not have enough detail to separate these groups and hence we have to work with a coarser definition where public administration and SOEs are in one group.

[8] In a nutshell, we assume that the ranking of the scores are preserved as we go from year 2011 (old score system) to year 2012 (new score system). The estimated regression is $NS_i = 6.4 + 9.1 \times OS_i$ where i indexes countries, NS is the new-system score in 2012, OS is the old-system score in 2011. We find that the resulting time series are generally well behaved.

[9] https://www.worldbank.org/en/publication/worldwide-governance-indicators/documentation.

dimensions: *i*) diversion of public funds, *ii*) public trust in politicians, *iii*) irregular payments and bribes. The index is available between 2007 and 2017. See World Economic Forum (2017) for more details. To make ECI comparable to CCI, we demean ECI so that the average ECI score is zero.

Given that these indices largely rely on similar sources, they tend to be highly correlated (Figure 1). At the same time, the correlation is imperfect and one can observe important high-frequency differences in the scores. For example, Figure 2 plots time series of the three indices for Ukraine. CPI and CCI follow each other relatively closely after 2004 and track major political developments in Ukraine (the Orange Revolution in 2004 and the Euromaidan (also known as the Revolution of Dignity) in 2013) but there are large discrepancies in the late 1990s and early 2000s: CPI suggests a major deterioration in terms of corruption while CCI suggests steady improvement. ECI has a shorter time series and thus it is harder to draw firm conclusions, but some scores raise questions. The presidency of Viktor Yanukovych in 2010-2014 is generally regarded as the era of utmost corruption in Ukraine (e.g., Åslund 2014) and yet ECI reports that ethics and corruption issues have been improving during this period (CPI and CCI report deterioration for this period). We conclude that the indices generally agree on the ranking of the countries over the longer run, but high-frequency variation is noisy and possibly unreliable.

E. Additional data

Versions of specification (2) have been estimated by many other studies thus giving us independent estimates of α. Specifically, we use public sector wage premia (compared to formal wage employees) reported in the World Bank's Worldwide Bureaucracy Indicators (WWBI). This database uses various surveys to estimate Mincerian wage regressions (i.e., specification (2)) at the worker level. In addition to the indicator variable for the public sector (α in our notation), regressions include controls consisting of age, age squared, level of education, location (urban/rural), and gender. The premium is reported as $100 \times [\exp(\alpha) - 1]$. World Bank (2022) and Gindling et al. (2020) provide more details. Demirgüç-Kunt et al. (2023) use these data to study how public sector wage premia are related to corruption perception indices.

IV. Results

In this section, we describe our estimates of the income premiums in the public sector as well as the relative consumption-income gaps for government employees. After documenting basic properties of these premia and validating our estimates, we relate the premia to popular corruption perception indices. Then we perform a battery of robustness checks and do a case study of Ukraine.

A. Properties of Public Sector Premia

Table 2 reports basic moments of estimated public sector consumption-income gaps (β in specification (1)) and income premiums (α in specification (2)). Consistent with earlier studies (e.g., Gindling et al. 2020, Panizza and Qiang 2005), we find that public-sector workers tend to earn a positive premium. While the average premium is 12.8% (the median is 10.0%), there is large variation across regions and countries. For instance, the average income premium in Western Europe and the European Union is 5.6% but it is much higher in the Pacific Asia (24.4%) and Sub-Sharan Africa (51.1%). The standard deviation of the income premiums is 14.5% thus suggesting dramatic heterogeneity.

To validate our estimates, we compare our results to the estimates reported in WWBI. Although the unit of analysis is different (we use household income while WWBI uses worker-level income), we find remarkable consistency in the estimates (Figure 3): the estimated slope coefficient is 1.20 (standard error 0.11) and R^2 is 0.58. However, there are occasional differences in the estimates (most notably Nicaragua and Bolivia in 2005). We conclude that on balance our approach produces sensible estimates and we can proceed to the next step.

When we focus on the difference between reported expenditures and incomes (β in specification (1)), we find that public-sector workers tend to have consumption-income gaps that are 10.4% lower than the gaps for private-sector workers. That is, relative to private sector workers, public sector workers have a lower level of consumer spending given their income. Recall that a positive value of the gap can be interpreted as suggesting that public-sector workers have a hidden source of income. Thus, if we focus on the level of the relative gap, public sector workers appear to consume less than their private-sector counterparts, which is consistent with more underreported income in the private sector.

To make further progress, we examine the joint distribution of public-sector income premia and consumption-income gaps. We find (Figure 4) that the two are strongly negatively correlated ($\rho = -0.65$) and this correlation remains strong even after controlling for country fixed effects. We also observe that this relationship is not driven by a particular region. This negative correlation suggests that higher compensation in the public sector may contribute to reducing corruption in the public sector (i.e., a lower C-Y gap). This finding contributes to a long-standing debate on whether efficiency wages in the public sector improve governance and reduce corruption. For example, Van Rijckeghem and Weder (2001) find that higher wages in the public sector are associated with lower corruption (in this case, one may expect a negative correlation between α and β). On the other hand, Foltz and Opoku-Agyemang (2015) find that increasing policemen's wages in Ghana was followed by an increase in the size of the bribes paid by truck drivers (in this case, one may expect a positive correlation between α and β). In other words, the correlation between α and β is *ex ante* ambiguous and we shed more light on the relationship in practice.

An alternative explanation could be that consumption and income are poorly measured in household surveys and hence the negative correlation can arise mechanically because income shows up with a negative sign in specification (1) (recall that the dependent variable is $\log(C_{it}/Y_{it}) = \log(C_{it}) - \log(Y_{it})$) and a positive sign in specification (2) (recall that the dependent variable is $\log(Y_{it})$). We note that measurement error appears in survey responses of both public and private workers. We also observe that the cross-sectional correlation between expenditures and income is quite strong (Figure 5) thus suggesting that expenditure data are not simply noise. As an additional test, we estimate

$$\log(C_{it}) = \gamma \times Public_{it} + \lambda \times \boldsymbol{X}_{it} + error \qquad (2)$$

and we report estimated γ in Panel C of Table 2. We find that the average $\hat{\gamma}$ is close to zero. This is consistent with the theoretical prediction that the utility (derived from consumption) should be similar in the public and private sectors. We also find that estimated λ (not reported) are consistent with theoretical predictions too (e.g., higher education is associated with higher levels of consumption). Hence, it is unlikely that noise in consumption data can rationalize the observed correlation between α and β.

B. Public Sector Income Premia and Corruption Perception Indices

As a first pass at the data, we focus on specification (2). Figure 6 plots the join distribution of the estimated αs and the CPI (at the time of the corresponding survey). We observe a crescent-like relationship: public sector employees have a higher income premium when CPI scores are either low (e.g., Indonesia) or high (e.g., Canada). The minimum income premium is achieved at CPI≈30. This pattern suggests that increased compensation of public-sector employees can improve CPI scores if a country is already relatively free of corruption. At the same time, countries with low CPI scores tend to compensate public sector employees above the market. Obviously, this does not mean that higher wages cause more perceived corruption. Instead, the elevated public-sector premium could reflect the attempts of the respective governments to root out corruption by raised compensation in the public sector so that government employees have weaker incentives to take bribes. This part of the crescent then indicates that increased compensation alone is not sufficient to reduce corruption. We also observe that countries like Russia and China have a negative income premium and low CPI scores, thus suggesting that public-sector wages should not fall behind the market. We view these results as broadly consistent with Demirgüç-Kunt et al. (2023) in the sense that the relationship between public-sector pay and perceived corruption is likely non-linear.

C. Public Sector Consumption-Income Gaps and Corruption Perception Indices

Next, we move to specification (1) which can speak more directly about the scale of corruption in a country. Figure 7 shows the joint distribution of estimated β and CPI scores. If higher βs and lower CPI scores capture more corruption, one should expect a negative relationship between the two. However, the relationship is a flipped crescent. For low values of CPI, β and CPI scores are positively correlated. This means that consumption is closer to (reported) income as we increase CPI scores but this convergence happens from below. In other words, when we start from a low base in terms of CPI scores (high corruption) and we observe an increase in the scores (corruption falls), we also observe that consumption "grows" closer to income (β moves towards 0). One may speculate that this convergence "from below" is consistent with public sector workers declaring their consumer spending more truthfully because they are less corrupt. However, the logic of our approach suggests that corrupt public sector workers should be less willing to report their income truthfully rather than their consumer spending which tends to cover routine spending such as expenditures on groceries. That is, convergence of consumption to income should happen from

above. Furthermore, for CPI between 40 and 60, there is little correlation (the fitted line is approximately vertical). For countries with CPI above 60, the correlation turns negative. We observe similar results when we use the WGI Corruption Control Index or the WEF Ethics and Corruption Index.

Our results linking estimated public-sector income premium α and the premium in consumption-income gap β suggest that perceptions of corruption and experienced corruption can diverge. If one is willing to entertain the possibility that the relative consumption-income gap is a better measure of actual corruption, then our results indicate that raising wages of public sector workers is associated with lower levels of corruption.

D. Robustness checks

Policy discussions often focus on year-to-year variation in the scores of the popular corruption indices or the long-term (average) rankings of countries in terms of these indices. In our context, the advantage of the averages is that they pool data and hence reduce noise in the estimates. The advantage of the changes is that they effectively control for the country fixed effect and thus can address variation in the design of household surveys across countries and other country specific factors (e.g., climate). We examine each of these in turn.

We find (Figure 10) that using averages yields broadly similar results although the relationships become somewhat more monotonic. However, the relation is inconsistent with the basic intuition: an increase in β (that is, reported consumption gets closer to reported income) should be associated with lower corruption (that is, higher corruption perception scores in the popular indices of corruption), while we find the opposite result. Note that, as discussed before, because β tends to be negative, an increase in β for low corruption perception scores actually means that consumption is getting closer to income but this convergence happens from below rather than from above. The fitted relation is quite steep when β approaches zero. This suggests that "long-run" corruption scores do not appear to be driven by the differences between income and consumption in the public sector.

We use two versions of changes. The first one identifies years with minimum and maximum corruption scores (we identify these for each index separately) and computes the difference for corruption scores as well as differences for estimated α and β for the years that correspond to those

scores. This is a "long difference" that reduces the influence of measurement errors in panel data (Griliches and Hausman 1986). The second one computes (short) differences for adjacent years with non-missing data. While this approach is likely to have large measurement errors, there are potentially many more observations.

For short differences, there is a weak, positive correlation between β and CPI scores (Figure 11), that is, the sign of the relation is "wrong". The correlation is negative for the WEF Ethics and Corruption Index and the WGI Corruption Control Index (i.e., the "right" sign). This cacophony in the estimated relationships suggests that year-to-year variation in corruption perception indices can be quite noisy and largely unrelated to changes in objective measures of corruption. Furthermore, the sensitivity of the correlation to which specific index of perceived corruption is used hints that relatively small variations in the design of corruption perception indices can yield large changes of the index. We report similar findings for long differences (Figure 12). Interestingly, some of the highest gains in CPI scores (Poland and Italy) are achieved with fairly small changes in α or β. One can view these features of the existing indices as undesirable.

E. Ukraine

To better understand the relationship between corruption perception indices and public sector premia, we do a case study of Ukraine. Figure 13 displays data as time series (Panel A) and scatter plots (Panel B). In addition to estimates α and β, we also report the aggregate wage premium in public administration relative to manufacturing (the results are similar when we use other sectors). Specifically, we follow Van Rijckeghem and Weder (2001) and use the log ratio of average wages in each sector. We observe that this aggregate premium is strongly correlated with CPI: $\rho = 0.66$ for the full sample and $\rho = 0.79$ when we exclude the drop of the CPI in year 2000. In contrast, the correlation between CPI and the income premium after controlling for worker and household characteristics drops to $\rho = 0.28$. We also note that the "aggregate" premium and the "adjusted" premium are negatively correlated ($\rho = -0.09$). Finally, the handful of observations for the public-sector premium in the consumption-income gap do not seem to give a robust relationship with CPI. Unfortunately, the last wave of ULMS was fielded in 2013 and thus we do not know if the big push in reforming public administration after the Euromaidan in 2014 (VoxUkraine 2018) affected adjusted premia in the public sector.

These results suggest that CPI appears to load strongly on the "aggregate" premium and weakly on more refined measures of premia in the public sector. Perhaps, data constraints lead to such loadings but with increasing access to micro-level data, adjusted premia likely provide a more precise picture for the state of affairs in the public sector. Indeed, as discussed in earlier studies (e.g., Bardhan 1997, Bender 1998), the fact that public sector workers earn more than their private sector counterparts on average does not mean that public sector workers are adequately compensated for their qualifications. Mincerian regressions similar to specification (1) give a better alternative.

V. Discussion and Concluding remarks

Corruption is a multi-dimensional object which makes measurement and policy response difficult. Furthermore, the hydra of bribery and graft constantly adapts thus turning into a moving target. As a result, one may be pessimistic about controlling this blight and yet control we must. While corruption perception indices are invaluable tools to aggregate vast amounts of information, the subjective nature of the underlying data can undermine the credibility of the indices and limit comparisons across time and space. Thus, there is much demand to develop indices relying on objective data and providing direct and credible statistics that summarize the extent of corruption.

This may seem to be an impossible task but the profession has made strong progress in this arena and we have now a number of indicators that have these desirable properties. As a part of this effort, we document that household surveys can be a part of the anti-corruption toolkit. Specifically, the gap between expenditures and incomes for public sector workers (relative to private sector workers) can be a useful element of corruption indices. Using standard regression analysis, the gap can be easily scaled to cover many countries and years. Because surveys can be collected at high frequencies, the gap can provide a timely measure of corruption that varies with the facts on the ground rather than rely on reputation or perceptions that exhibit a significant lag. Furthermore, the gap can be used to quantify the extent of corruption, something that subjective and qualitative survey responses cannot achieve. As we demonstrate in the paper, the gap can also be used to validate existing measures of corruption and identify areas for improvement.

Our analysis opens many avenues for future research and policy applications. We hope that the consumption-income gap will be used routinely to gauge the state of corruption and thus firmly tie policy discussions to the facts. We envision that future versions of this metric will use more

sophisticated surveys of households (e.g., more disaggregated measures of consumer spending which make concealing bribes more difficult, more detailed characteristics of respondents and households) and more advanced econometric techniques (e.g., quantile regressions to assess which part of the income/skill distribution is more likely to have problems with corruption).

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Table 1. Data sources.

Country	Years	Surveys	Approximate Average Household Sample Size (Main Data Source)	LIS/LI
Austria	1996-2000; 2003-2021	European Community Household Panel (ECHP); Survey on Income and Living Conditions (SILC)	5,000	A
Belgium	2000; 2004-2020	Panel Study on Belgian Households (PSBH) / European Community Household Panel (ECHP); Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	6,000	2000; 20
Brazil	2001-2009; 2011-2015	National Household Sample Survey (PNAD)	100,000	A
Bulgaria	2010; 2015; 2020	Household Budget Survey (HBS)	3,000	
Canada	1999-2011	Survey of Labour and Income Dynamics (SLID)	30,000	A
Colombia	2007-2022	Great Integrated Household Survey (GEIH-M05); Great Integrated Household Survey (GEIH-M18)	200,000	A
Côte d'Ivoire	2008; 2015	Household Living Standards Survey (ENV)	10,000	A
Croatia	2010; 2015; 2020	Household Budget Survey (HBS)	2,000	
Cyprus	2010; 2015	Household Budget Survey (HBS)	2,000	
Czechia	2020	Household Budget Survey (HBS)	3,000	
Denmark	2015	Household Budget Survey (HBS)	2,000	
Dominican Republic	2007	National Household Survey of Income and Expenditures (ENIGH)	8,000	A
Egypt	1999; 2004; 2008; 2010; 2012; 2015; 2017	ERF Harmonised Household Income and Expenditure Surveys (HHIES), Household Income, Expenditure and Consumption Survey (HIECS)	30,000	X
Estonia	2007; 2010; 2013; 2016; 2020	Estonian Social Survey (ESS) / Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	5,000	2007; 20 20
Finland	2015; 2020	Household Budget Survey (HBS)	3,000	
France	2010; 2015	Household Budget Survey (HBS)	20,000	
Georgia	2009-2016	Integrated Household Survey (IHS)	3,000	A
Germany	1995-2020	Income and Consumer Survey (EVS); German Socio-Economic Panel (GSOEP)	20,000	A

Greece	2000; 2007; 2010; 2013; 2015-2016	European Community Household Panel (ECHP); Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	9,000	2000; 200 2013;
Guatemala	2006; 2011; 2014	National Survey of Living Conditions (ENCOVI)	10,000	A
Hungary	1999; 2005; 2007; 2010; 2015; 2020	Tárki Household Monitor Survey; Household Budget Survey (HBS)	7,000	1999; 20
India	2004; 2011	India Human Development Survey (IHDS)	40,000	A
Iraq	2007; 2012	ERF Harmonised Household Income and Expenditure Surveys (HHIES), Iraq Household Socio-Economic Survey (IHSES)	20,000	A
Ireland	2000; 2010; 2015; 2019	Living in Ireland Survey / European Community Household Panel (ECHP); Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	5,000	2000;
Italy	1995; 1998; 2000; 2002; 2004; 2006; 2008; 2010; 2012; 2014; 2016; 2020	Survey of Household Income and Wealth (SHIW); Household Budget Survey (HBS)	8,000	A
Japan	2008; 2010; 2013	Japan Household Panel Survey (JHPS)	3,000	A
Jordan	2002; 2006; 2008; 2010; 2013	ERF Harmonised Household Income and Expenditure Surveys (HHIES), Household Expenditure and Income Survey (HEIS)	3,000	A
Latvia	2010; 2015; 2020	Household Budget Survey (HBS)	3,000	
Lithuania	2020	Household Budget Survey (HBS)	5,000	
Luxembourg	1997-2001; 2015; 2020	Socio-economic Panel Living in Luxembourg (PSELL II) / European Community Household Panel (ECHP); Household Budget Survey (HBS)	3,000	1997-
Malta	2015	Household Budget Survey (HBS)	4,000	
Mexico	1996; 1998; 2000; 2002; 2008; 2010; 2012; 2014; 2016; 2018; 2020; 2022	Household Income and Expenditure Survey (ENIGH)	30,000	A
Panama	2010; 2013; 2016	Continous Household Survey (ECH)	10,000	A
Paraguay	1999; 2002-2020	Continous Household Survey (EPH)	6,000	A
Peru	2004-2019; 2021	National Household Survey (ENAHO)	30,000	A
Poland	1999; 2004-2020	Household Budget Survey (HBS)	40,000	A
Portugal	2010; 2015	Household Budget Survey (HBS)	10,000	
Romania	2010; 2015; 2019-2020	Quality of Life Survey (ACAV) on which is based Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	30,000	20

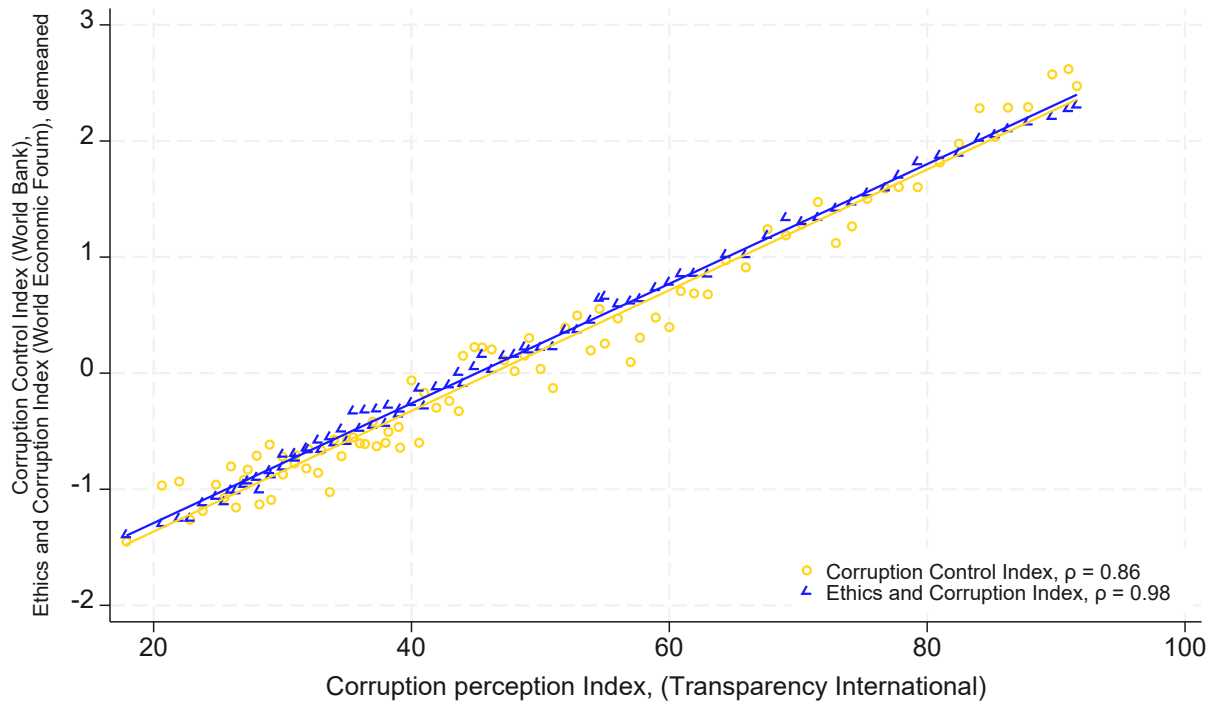
Russia	2004; 2007; 2010	Russia Longitudinal Monitoring Survey (RLMS)	4,000	A
Serbia	2016	Household Budget Survey (HBS)	5,000	A
Slovakia	2010; 2015; 2020	Household Budget Survey (HBS)	5,000	
Spain	2015; 2016; 2020	Survey on Income and Living Conditions (SILC); Household Budget Survey (HBS)	20,000	20
Switzerland	2019	Statistics on Income and Living Conditions (SILC)	8,000	A
Taiwan	1995; 1997; 2000; 2005	Family Income Distribution and Expenditure Survey	10,000	A
United States	1995-2022	Current Population Survey (CPS) - March Supplement; Current Population Survey (CPS) - Annual Social and Economic Supplement (ASEC)	60,000	A
Uruguay	2006-2019; 2022	Continuous Household Survey (ECH)	40,000	A
Vietnam	2007; 2009; 2011; 2013	Vietnam Household Living Standards Survey (VHLSS)	9,000	A
Phillipines	1997; 2006; 2009; 2012	Family Income and Expenditure Survey (FIES)	50,000	
Indonesia	1997; 2000; 2007; 2014	Indonesia Family Life Survey (IFLS)	10,000	
China	2010; 2012; 2014; 2016; 2018; 2020	China Family Panel Studies (CFPS)	10,000	
Bolivia	2003; 2005-2009; 2011-2019; 2020-2021	Encuesta de Hogares (EH)	8,000	
Nigeria	2011; 2013; 2016; 2019	General Household Survey (GHS)	5,000	
El Salvador	2010-2023	Encuesta de Hogares de Propósitos Múltiples (EHPM)	20,000	
Argentina	2005; 2013; 2018	Encuesta Nacional De Gastos De Los Hogares (ENGH)	20,000	
Nicaragua	2001; 2005	Encuesta Nacional de Hogares sobre Medicion de Nivel de Vida (EMNV)	5,000	
Costa Rica	2013; 2018	National Household Income and Expenditure Survey (ENIGH)	6,000	
Ukraine	2003; 2004; 2007; 2012	Ukraine Longitudinal Monitoring Survey (ULMS)	3,000	

Table 2. Descriptive statistics for public sector premia.

Region	mean	median	std	Number of observations	Number of countries
	(1)	(2)	(3)	(7)	(8)
Panel A. C-Y gap premium, β					
Americas (AME)	-0.163	-0.109	-0.109	180	16
Asia Pacific (AP)	-0.069	-0.064	-0.064	28	7
Eastern & Central Europe (ECA)	-0.032	-0.021	-0.021	16	4
Middle East and North Africa (MENA)	-0.068	-0.055	-0.055	14	3
Sub-Saharan Africa (SSA)	-0.262	-0.261	-0.261	6	2
Western Europe & European Union (WE/EU)	-0.048	-0.045	-0.045	156	24
All	-0.104	-0.105	-0.064	400	56
Panel B. Income premium, α					
Americas (AME)	0.169	0.139	0.139	180	16
Asia Pacific (AP)	0.244	0.185	0.217	28	7
Eastern & Central Europe (ECA)	0.048	0.042	0.108	16	4
Middle East and North Africa (MENA)	0.103	0.106	0.068	14	3
Sub-Saharan Africa (SSA)	0.511	0.491	0.211	6	2
Western Europe & European Union (WE/EU)	0.056	0.045	0.067	156	24
All	0.128	0.100	0.145	400	56
Panel C. Consumption premium, γ					
Americas (AME)	0.006	-0.004	0.147	180	16
Asia Pacific (AP)	0.172	0.158	0.104	28	7
Eastern & Central Europe (ECA)	0.008	0.034	0.081	16	4
Middle East and North Africa (MENA)	0.031	0.046	0.100	14	3
Sub-Saharan Africa (SSA)	0.220	0.249	0.074	6	2
Western Europe & European Union (WE/EU)	0.006	-0.003	0.053	156	24
All	0.022	0.003	0.121	400	56

Notes: Consumption-Income (C-Y) gap premium β is calculated using specification (1). Income premium α is calculated using specification (2). Consumption premium γ is calculated using specification (3).

Figure 1. Consistency of various corruption indices.



Notes: This figure is a binscatter plot comparing corruption indices constructed by various organizations.

Figure 2. Time variation in corruption Indices: Ukraine.

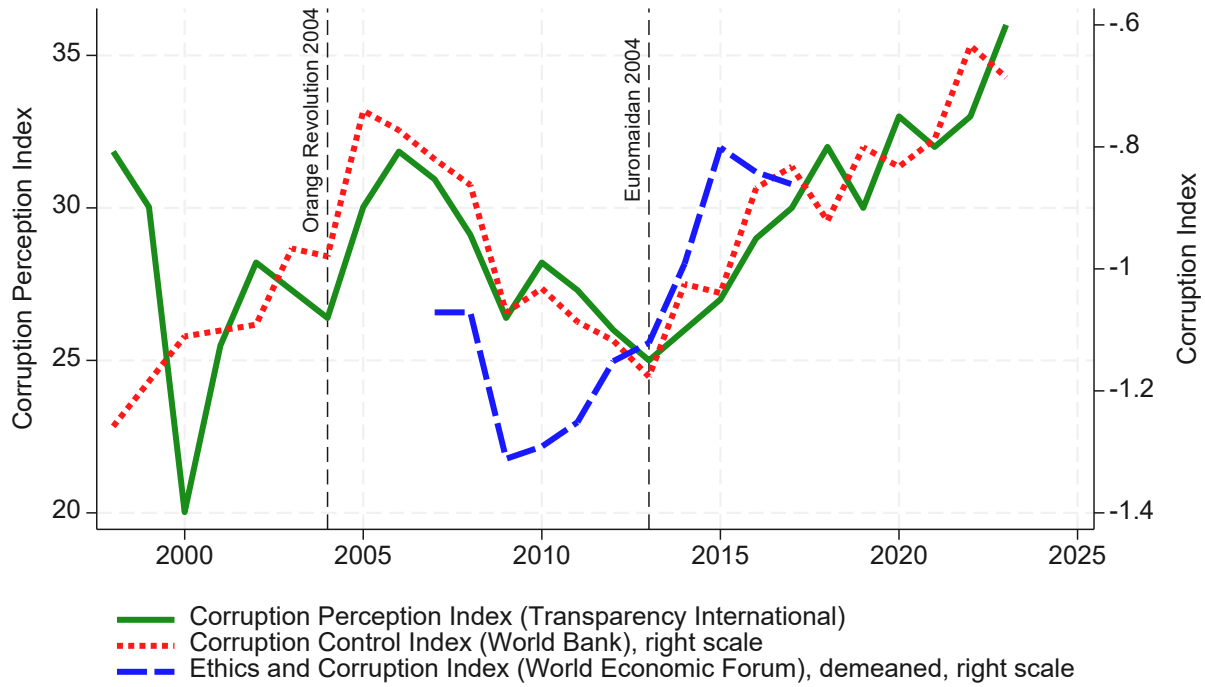
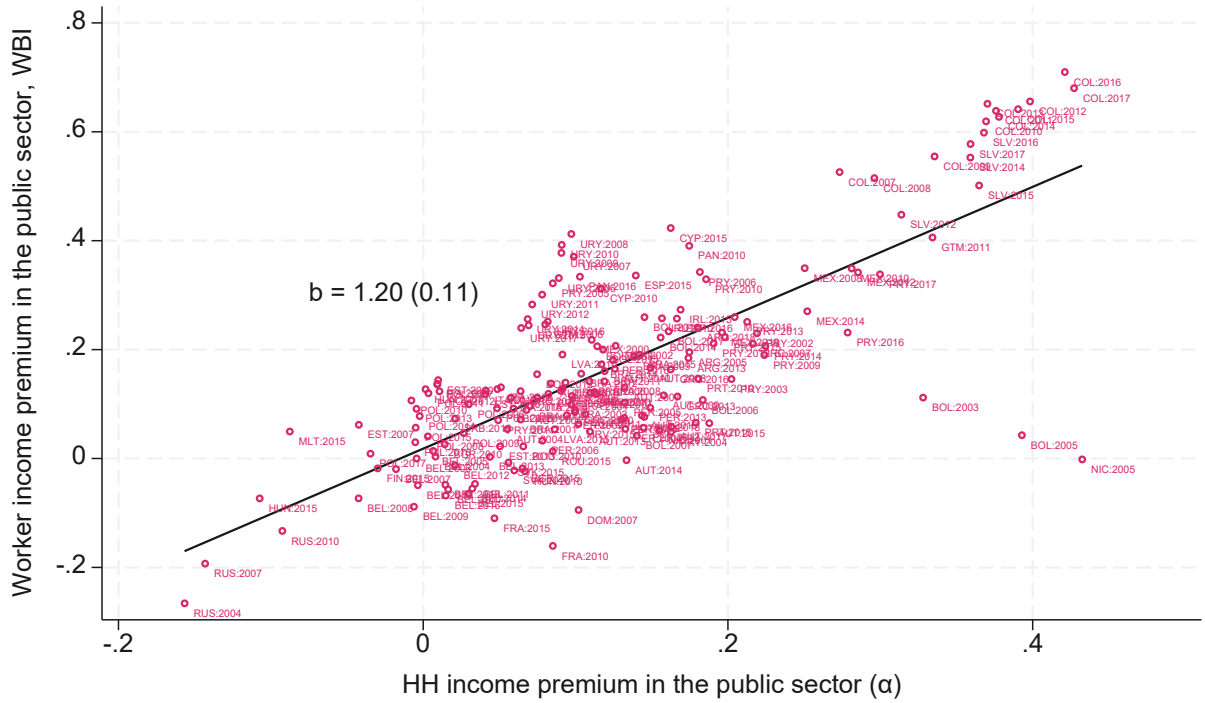
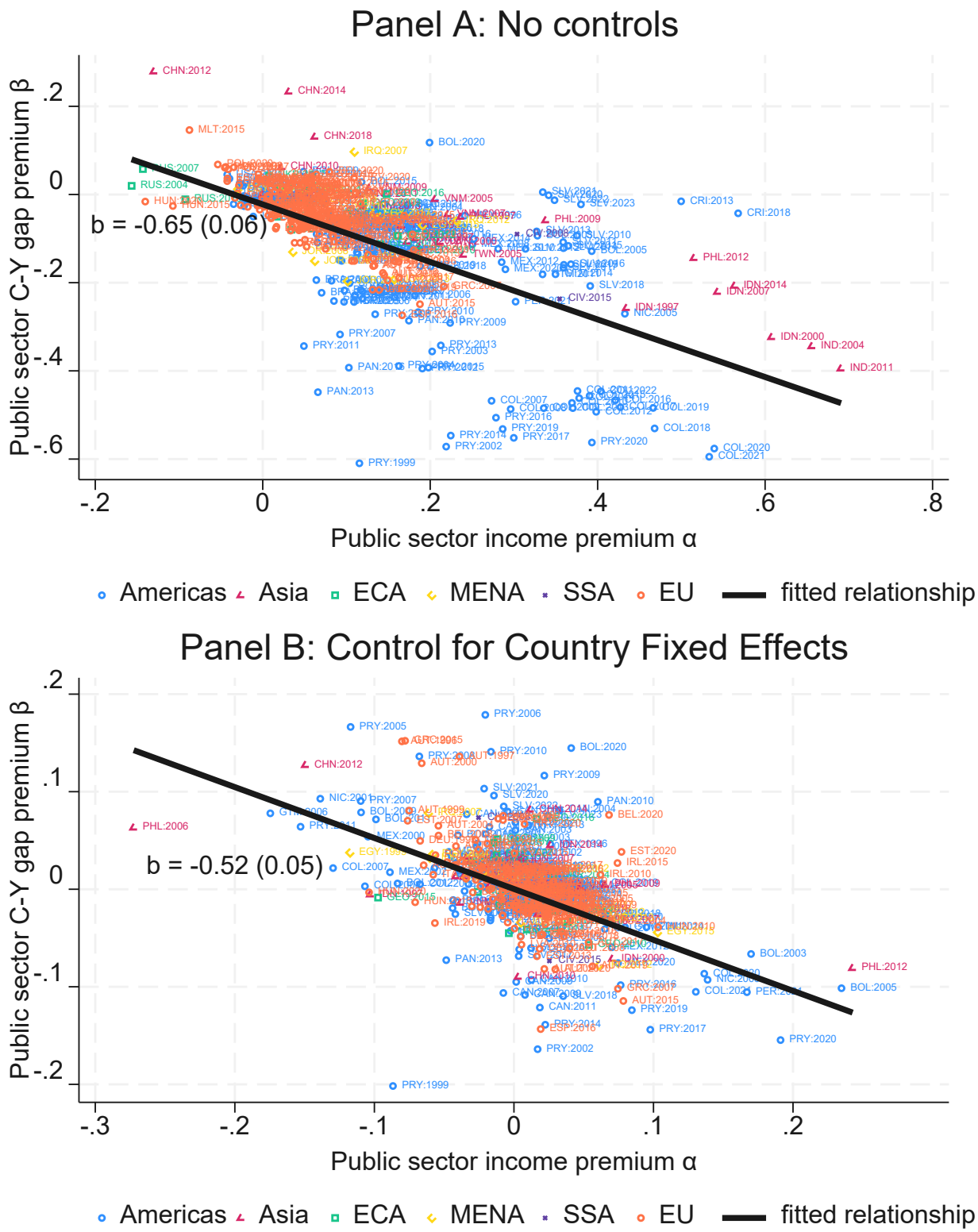


Figure 3. Validation of wage premium in the public sector.



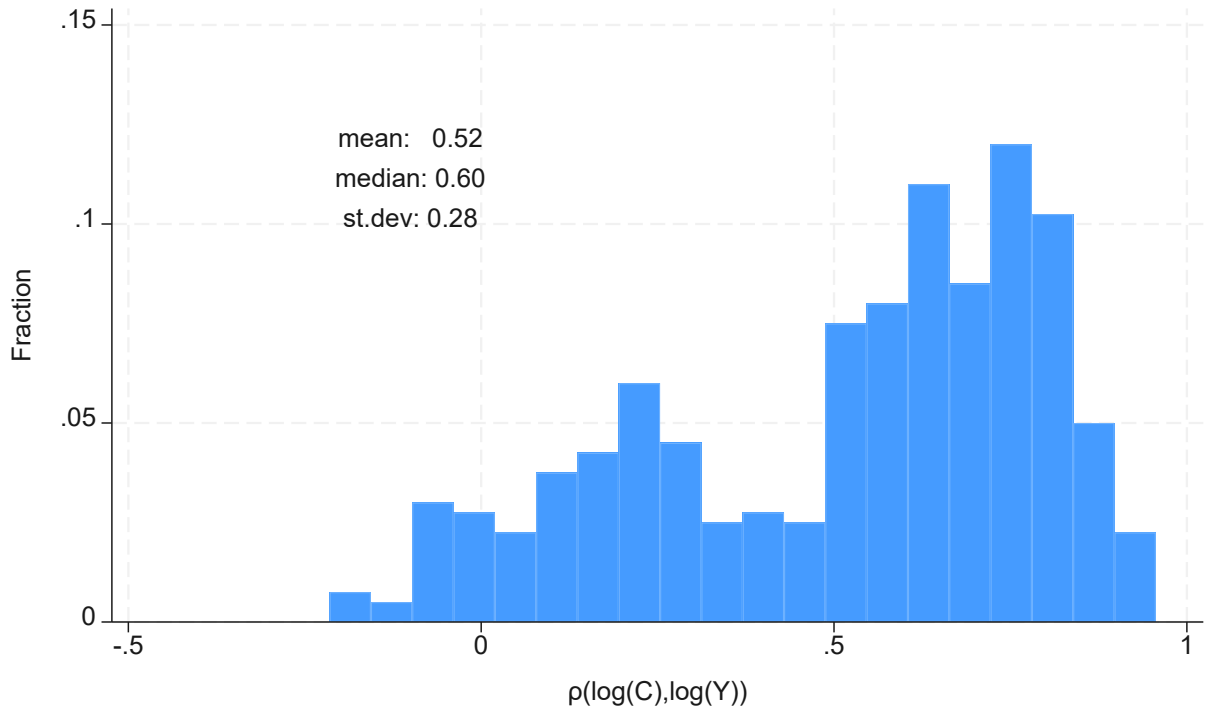
Notes: Income premium α (horizontal axis) is calculated using specification (2). Worker income premium is from the World Bureaucracy Indicators (BI.WAG.PREM.PB) Public sector wage premium (compared to formal wage employees).

Figure 4. α vs β.



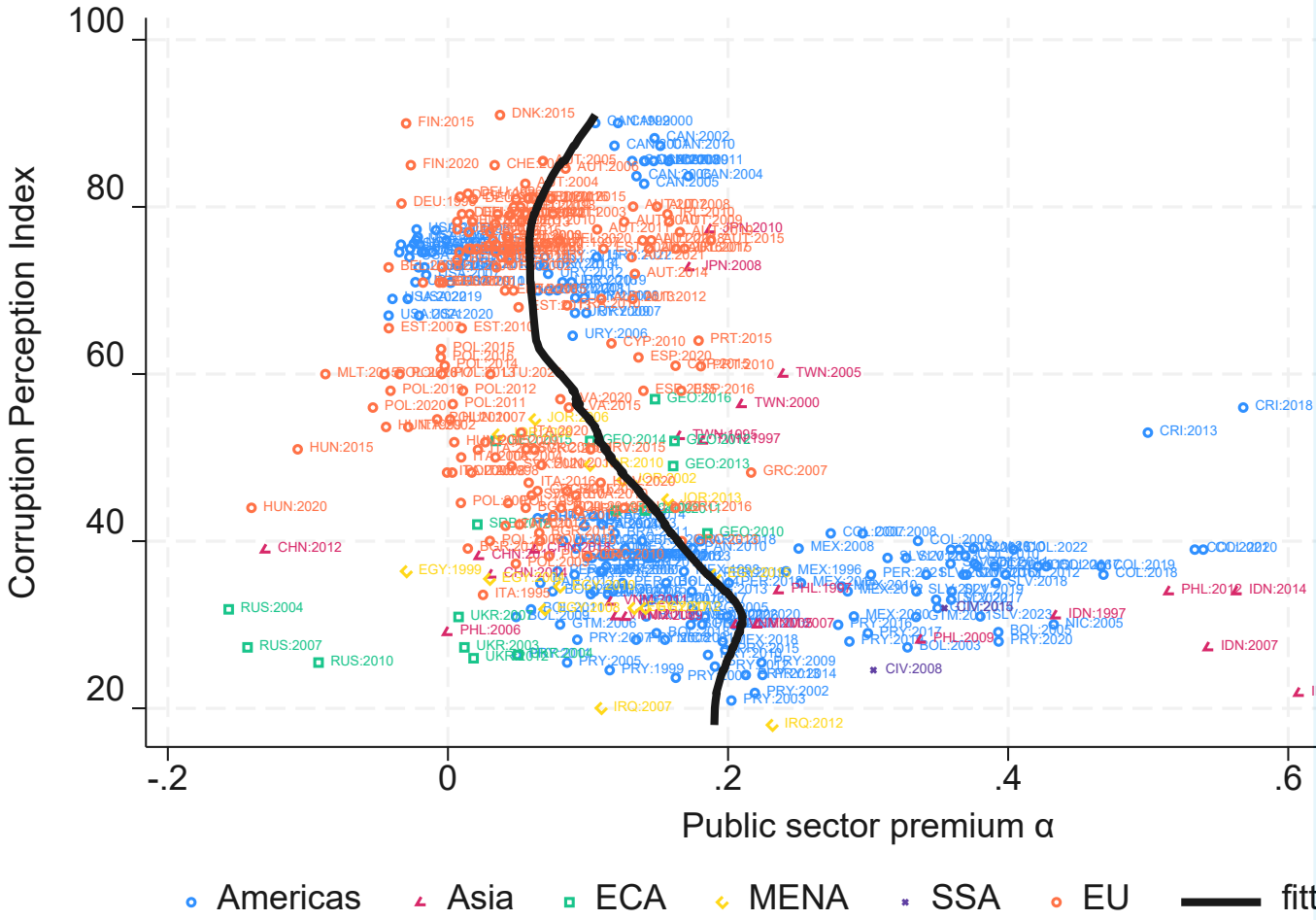
Notes: Consumption-Income (C-Y) gap premium β is calculated using specification (1). Income premium α is calculated using specification (2).

Figure 5. Correlation between incomes and expenditures.



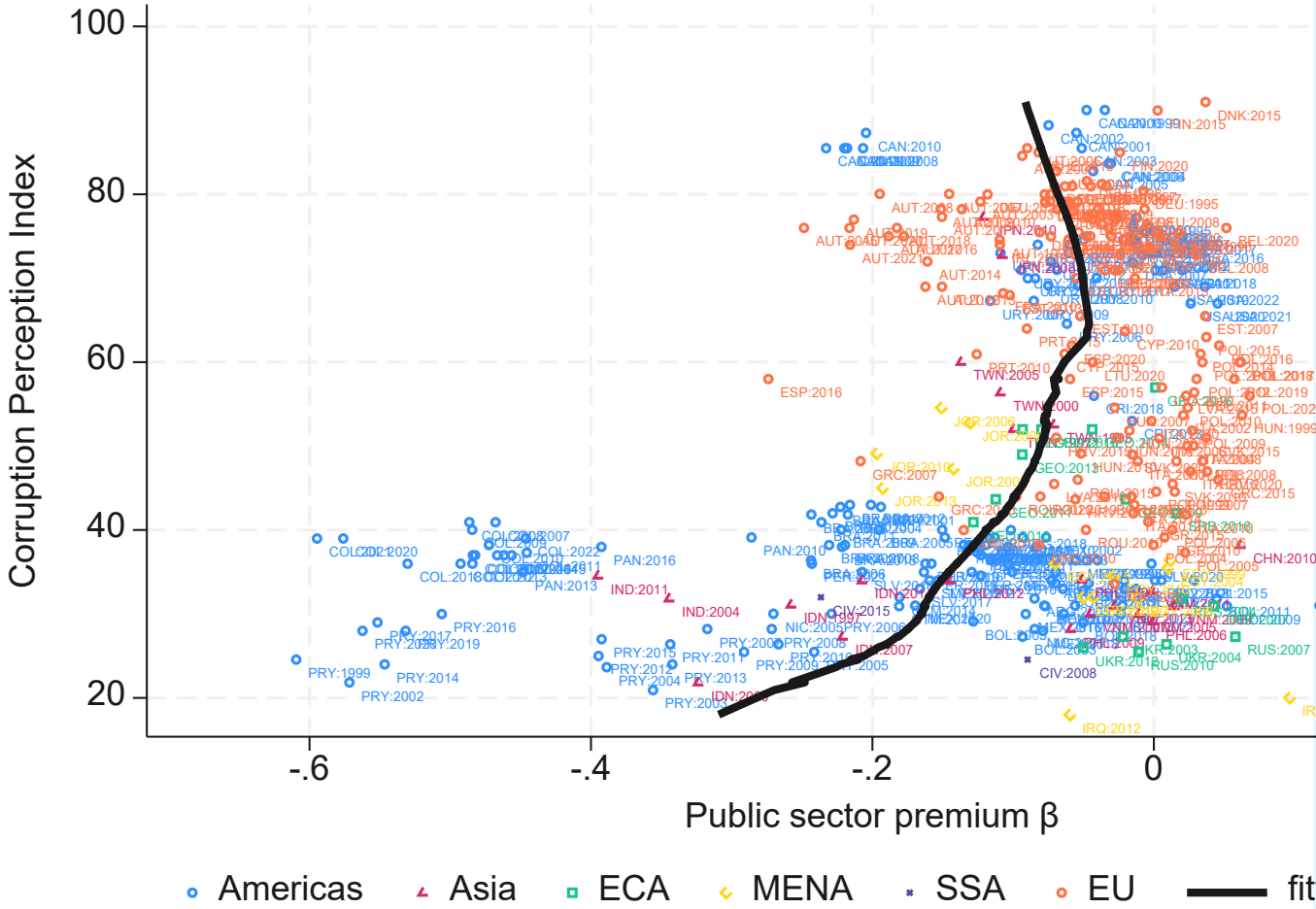
Notes: The histogram shows the distribution of the correlations between consumption and income estimated for each country-year separately.

Figure 6. Public sector wage premium vs. Corruption Perception Index.



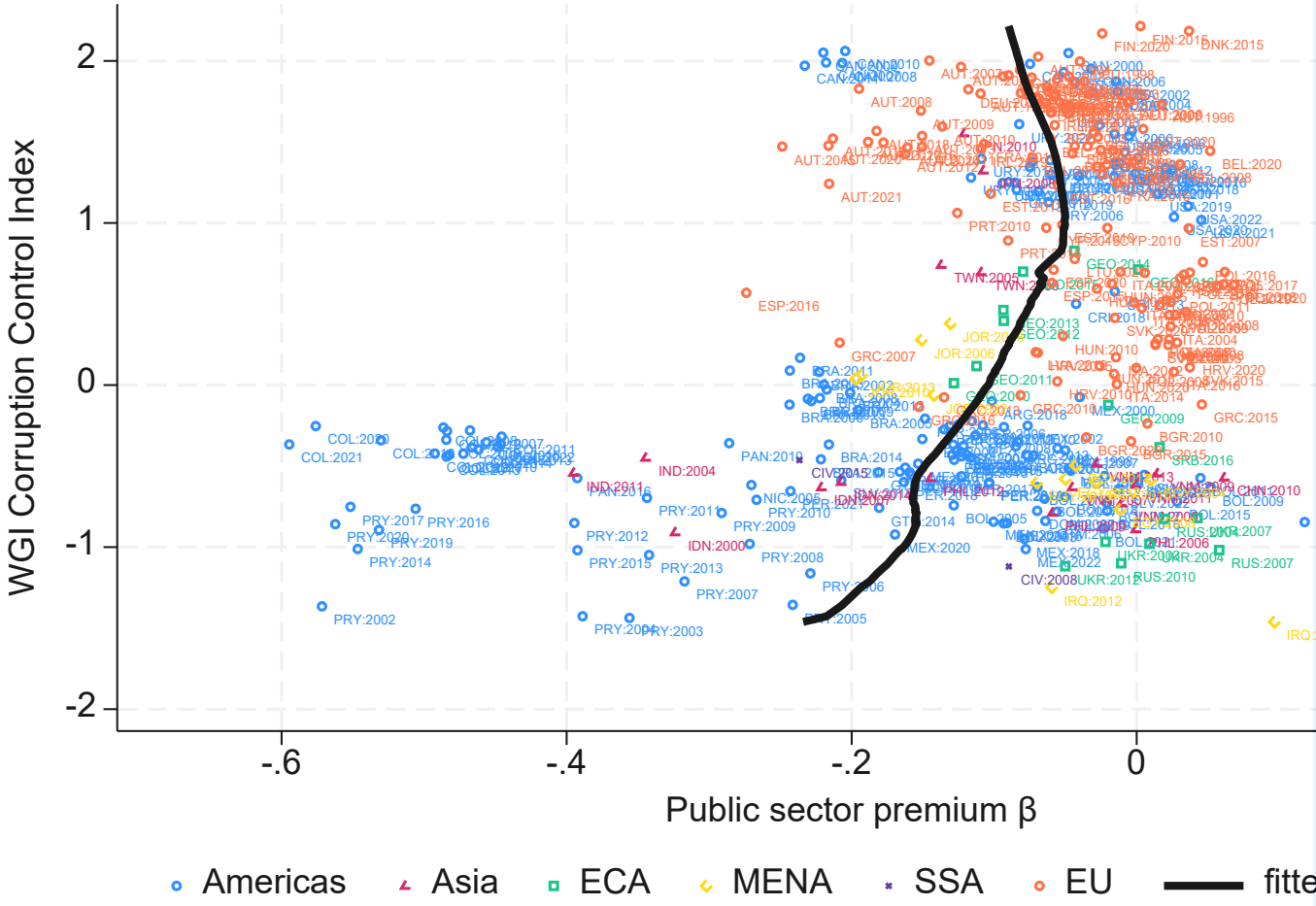
Notes: The horizonal axis is α in specification (2). The fitted line is done with lowess.

Figure 7. Public sector consumption/income premium vs. Corruption Perception Inde



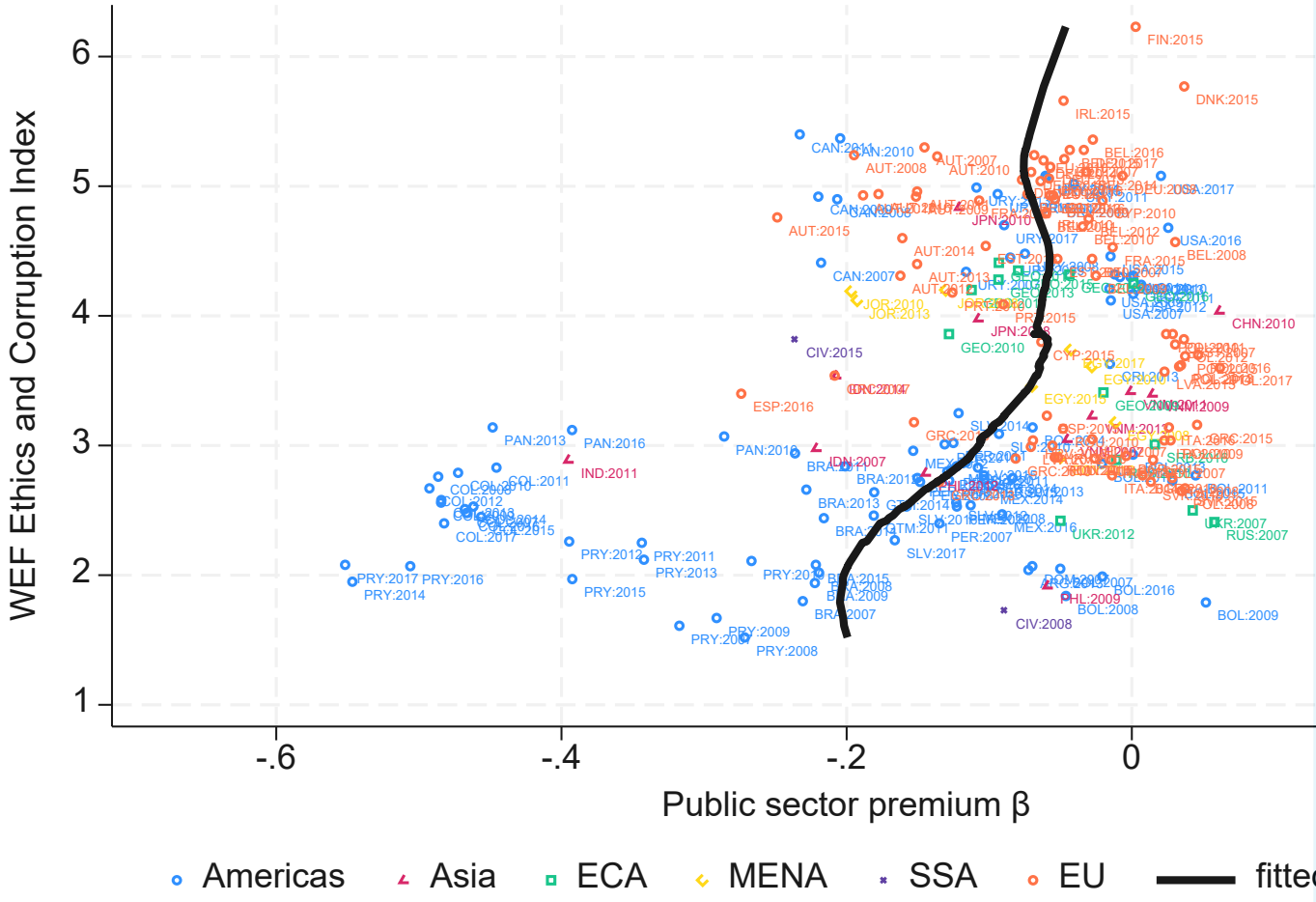
Notes: The horizonal axis is β in specification (1). The fitted line is done with lowess.

Figure 8. Public sector consumption/income premium vs. WGI Corruption Control Ind



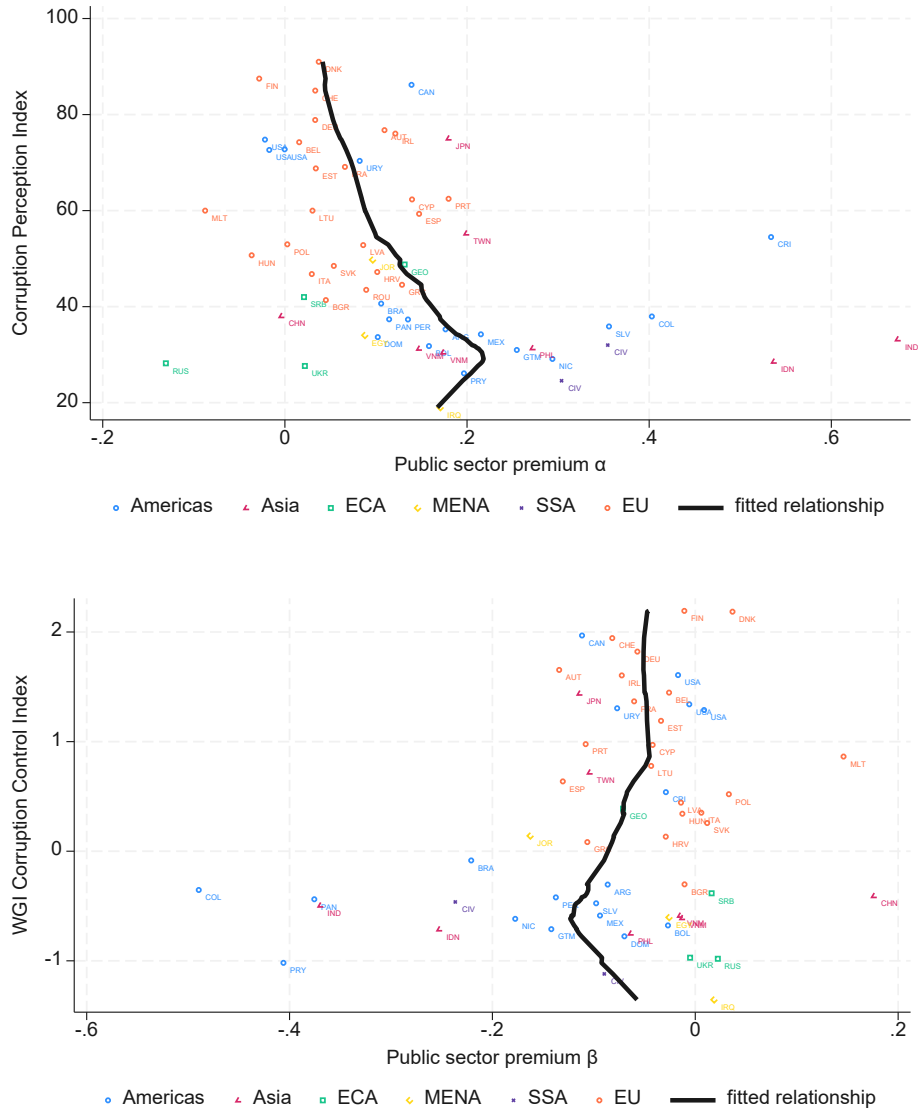
Notes: The horizonal axis is β in specification (1). The fitted line is done with lowess.

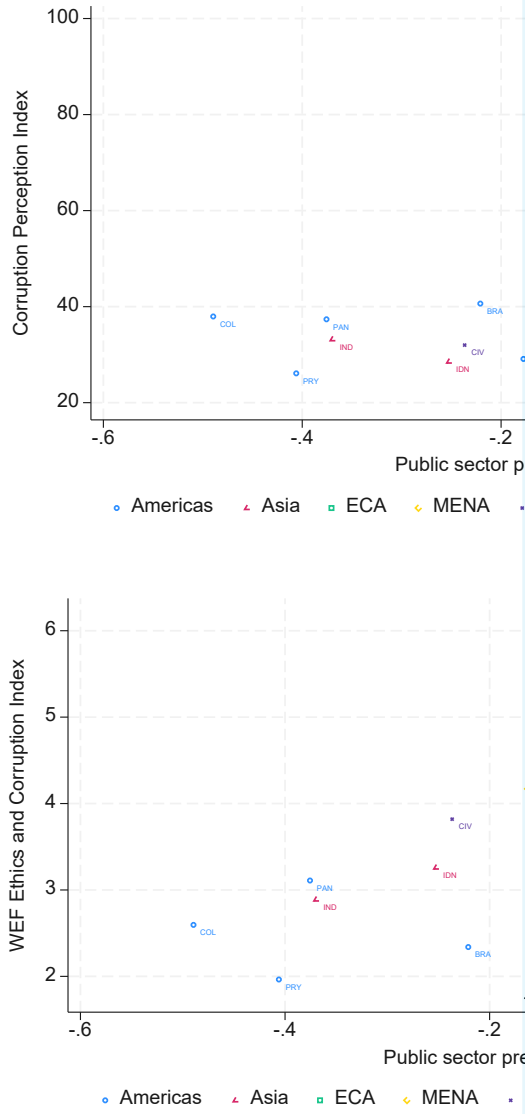
Figure 9. Public sector consumption/income premium vs. WEF Ethics and Corruption I



Notes: The horizonal axis is β in specification (1). The fitted line is done with lowess.

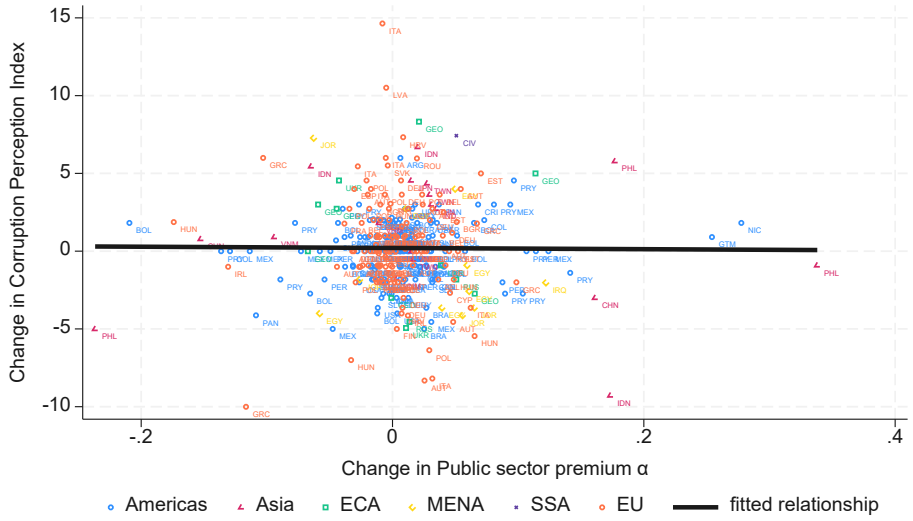
Figure 10. Aggregated Public Sector Premia vs. Corruption Indices.

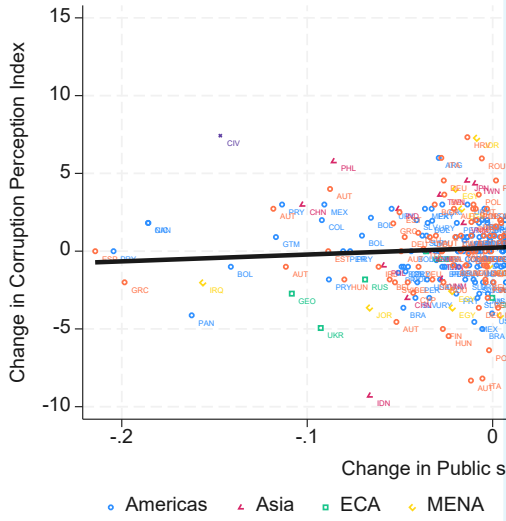


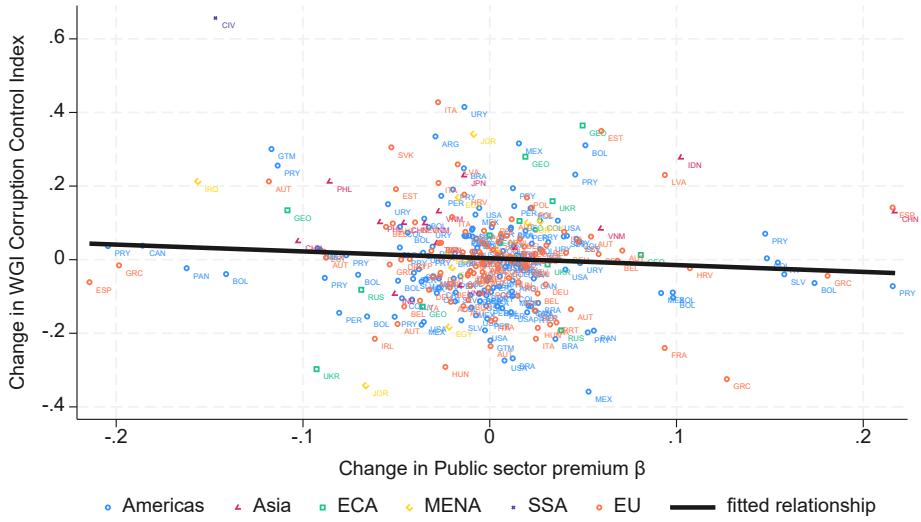


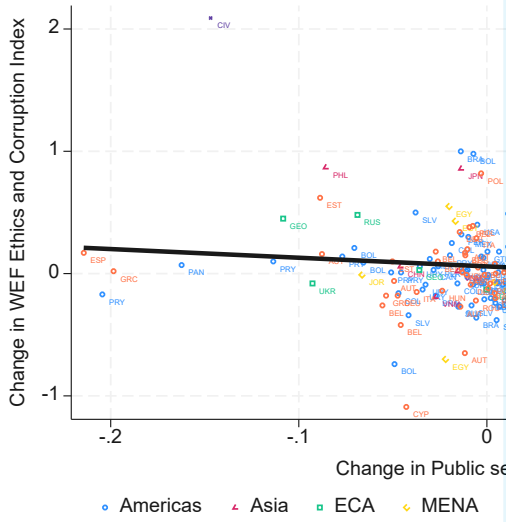
Notes: The horizonal axis in the upper left panel is α in specification (2). The horizonal axis in other panels is β in specificatio
lowess.

Figure 11. Differences in Public Sector Premia and Scores of Corruption Indices.



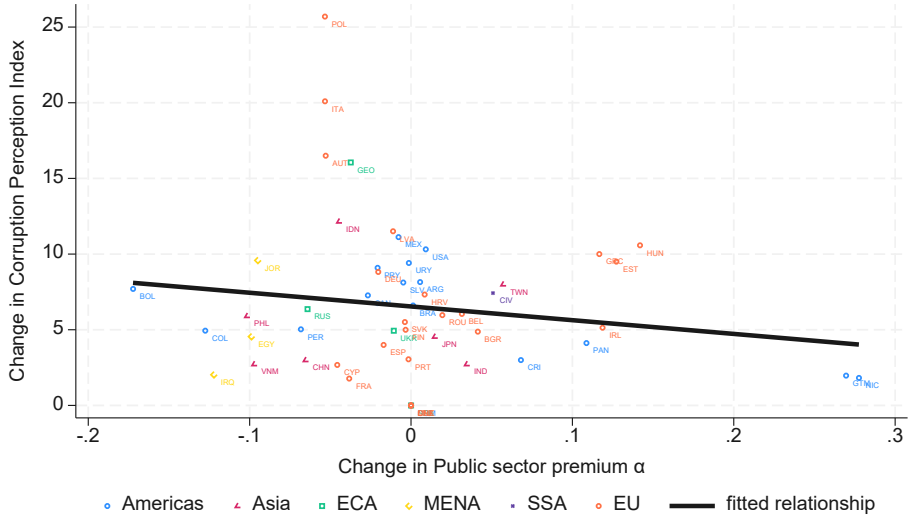


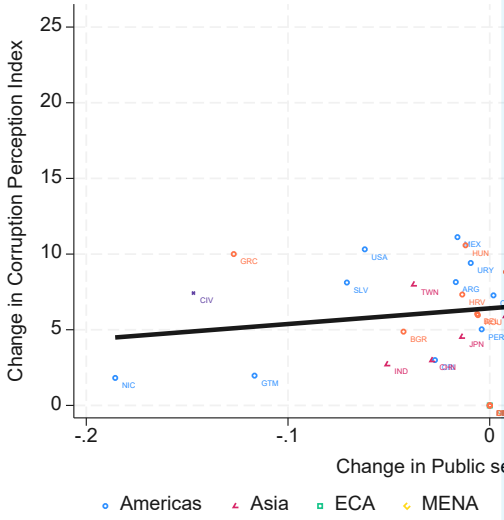


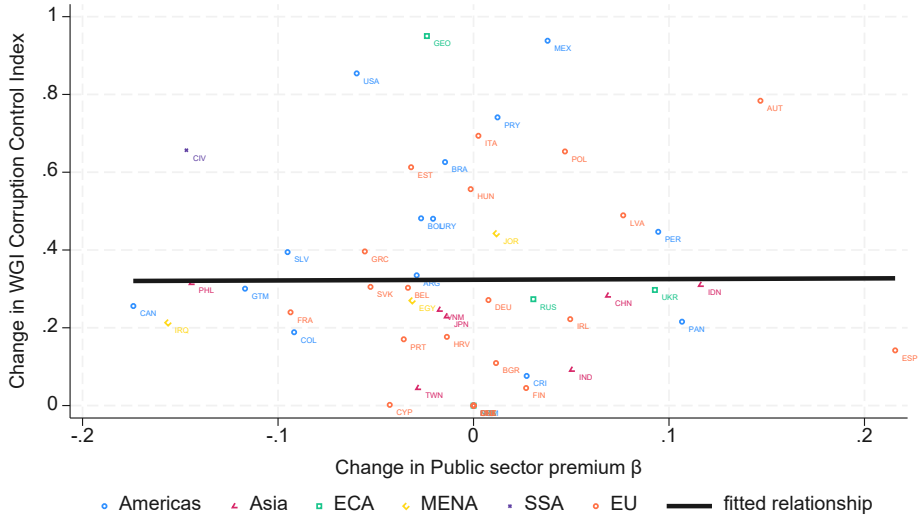


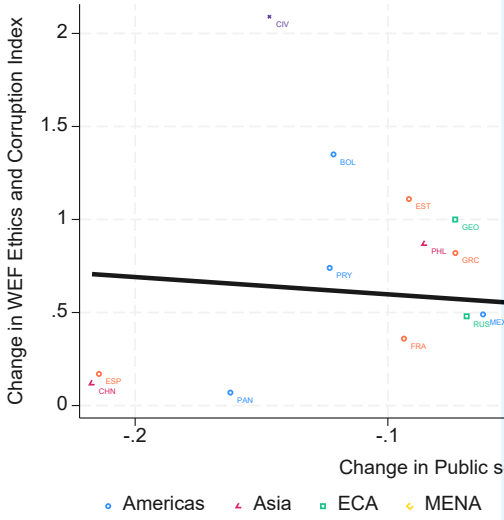
Notes: The horizonal axis in the upper left panel is α in specification (2). The horizonal axis in other panels is β in specificatio
OLS.

Figure 12. Long differences in premia and corruption scores.



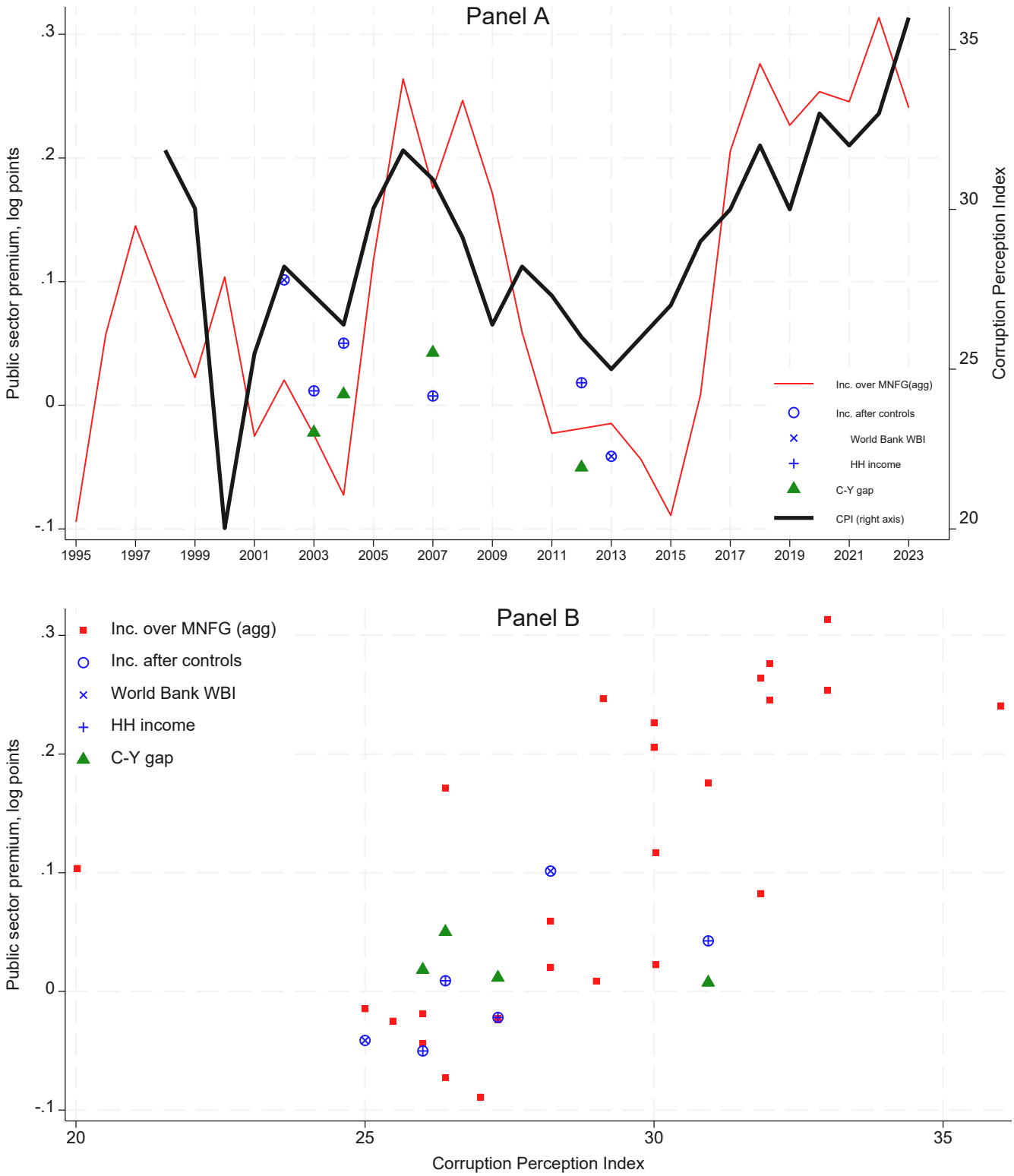






Notes: The horizonal axis in the upper left panel is α in specification (2). The horizonal axis in other panels is β in specificatio
OLS.

Figure 13. Comparison of Corruption Perception Index and Public Sector Premia in Ukraine.



Notes: *Inc. over MNFG (agg)* measures the log ratio of average wages in public administration to average wages in manufacturing (source: State Statistics Service of Ukraine). *Inc. after controls* measures the wage premium in the public sector relative to the private sector (α in specification (2)). The sources are the World Bank's World Bureaucracy Indicators and our calculations for household incomes in the ULMS. *C-Y gap* is the public sector premium in the consumption-income gap (β in specification (1)); our calculations for household income and spending in the ULMS.