



Electricity subsidy reform in Indonesia: Demand-side effects on electricity use

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ABSTRACT

Indonesia's budget has for years been burdened by large subsidies for electricity consumption. A series of recent reforms has delivered a substantial reduction in these subsidies. In this paper we estimate demand-side effects of these reforms on electricity use. Our analysis utilizes a three-dimensional dataset covering six consumer groups, 16 regions, and 1992–2015. We control for various fixed effects, and use an instrumental variable approach. Our estimates suggest that subsidy reductions since 2013 had induced savings in annual electricity use of around 7% relative to the no-reform counterfactual as of 2015. The phase-out of remaining subsidies has the potential to generate further improvements in the efficiency of electricity use, while freeing up resources for other priorities such as infrastructure spending.

1. Introduction

Indonesia, with a population exceeding 258 million people, has recently pursued one of the world's most ambitious programs of electricity subsidy reforms. In this study we use panel data for 1992–2015 to estimate the price elasticity of demand for electricity in Indonesia. We use our estimates to quantify the demand-side effects of Indonesia's electricity subsidy reforms on electricity use. Our dataset covers six consumer groups – residences, business, industry, social services, government buildings, and public street lights – and 16 regions.

Indonesia's history of subsidies for the consumption of electricity is a long one (McCawley, 1970; Kristov, 1995; Soesastro and Atje, 2005; Burke and Resosudarmo, 2012). The subsidies result from electricity tariffs that have been set at a level below the cost of supplying electricity. The taxpayer has been required to make up the difference, via subsidy payments to the electricity utility *Perusahaan Listrik Negara* (PLN). Infrequent increases in electricity tariffs, together with strong growth in electricity use and increases in the cost of supplying electricity, saw the official value of Indonesia's annual electricity subsidy expenditure balloon to 95 trillion IDR (US\$10 billion) in 2012. This was an on-budget expense item for the national government that equalled 6% of the value of central government expenditure and transfers, and 1% of gross domestic product (CEIC, 2016). According to the International Monetary Fund (2015) pre-tax measure, in 2013 Indonesia had the world's 4th-largest electricity subsidies in US dollar

terms, after Russia, Iran, and Saudi Arabia. By “subsidy” we refer to electricity consumption subsidies associated with below-cost electricity tariffs (not government spending on electricity infrastructure).

Indonesia's electricity subsidies have been notionally justified by reasons such as assisting the poor, aiding industrial competitiveness, and helping to stabilize prices. The subsidies have been poorly targeted, however, with the well-off receiving a large share. Financial difficulties caused by low electricity tariffs have also reduced the direct incentive for PLN to expand access to less-served areas. Subsidizing electricity is likely to encourage inefficient electricity use and excessive emissions in the process of electricity generation.

In recent years Indonesia has introduced a series of historic reforms to electricity tariffs in an attempt to reduce the size of its electricity subsidies. The reforms are consistent with Electricity Law No. 30/2009, which requires the government to connect underserved areas to electricity and supply electricity to the poor, but does not envision broad subsidies for electricity use. Relatively large increases in electricity tariffs have been phased in since 2013, with subsidies now fully eliminated for some consumers. The bulk of remaining subsidies flow to residences. The reforms were implemented both during the final years of the Yudhoyono presidency and the first years of the Widodo presidency. Subsidies for the consumption of gasoline and diesel for transport have also been reduced (Yusuf et al., 2016).

Reductions in electricity subsidies should be expected to provide an attractive means of improving the efficiency with which electricity is

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used. This is because high-value uses of electricity will proceed even after consumers shift to paying a cost-reflective price. Improved efficiency of electricity use in turn alleviates the need for supply-side investments. Electricity infrastructure is expensive: the announced cost of Indonesia's ongoing 35 gigawatt capacity expansion project was more than 1100 trillion IDR (US\$82 billion; PLN, 2016b). Phasing out fossil fuel subsidies is a key commitment of the international community, as pledged by the G20 and Asia-Pacific Economic Cooperation (APEC) in 2009. Indonesia's electricity generation is predominantly fossil-fuel based, with coal (56% of electricity generation in 2015), natural gas (25%), and oil (8%) dominating the mix (International Energy Agency [IEA], 2017a). Hydro (6% of generation) and geothermal (4%) also make quite important contributions.

In estimating the short-run price elasticity of electricity demand, we use two strategies to control for non-price factors – both supply-side and demand-side – that potentially affect electricity use and that are also potentially correlated with electricity prices. The first is to include a set of observed controls. The second is to control for multiple dimensions of fixed effects. In our three-dimensional panel we control for factors common to consumer groups in any region (across all years), regions in any year (across all consumer groups), and consumer groups in any year (across all regions). Identification is also aided by the observation that the timing of and motivation for electricity tariff decisions have been largely determined by budgetary and political considerations. The timing and scale of changes to electricity tariffs have also varied by consumer group. In addition, we pursue an instrumental variable (IV) approach that exploits the three-dimensional nature of our study setting.

We find that electricity demand in Indonesia is price inelastic, with a same-year elasticity of demand of -0.15 to -0.2 and a four-year elasticity of around -0.4 . That the elasticity is negative implies that Indonesia's subsidy reforms are contributing to demand-side savings in electricity use even in the relatively short run, of a magnitude that we will quantify. Our estimates will be able to assist the planning and budgeting of both PLN and Indonesia's government. They are of potential use to other developing countries, especially those embarking on reforms to electricity tariffs.

This paper provides the first known estimates of the price elasticity of aggregate electricity demand in Indonesia. The estimates add to findings from other countries. Khanna and Rao (2009) reviewed studies from developing countries, observing that the mean short-and long-run price elasticities of electricity demand are -0.4 and -0.6 . Espey and Espey (2004) carried out a meta-analysis of studies of residential electricity demand, reporting a mean short-run price elasticity of demand of -0.35 , and a long-run elasticity of -0.85 . Zhang (2014) concluded that electricity price increases have been important for industrial energy efficiency improvements in China, consistent with our finding for Indonesia. Wang and Lin (2017) estimated the potential effects of electricity subsidy reform for China's residential sector, concluding that substantial demand-side electricity savings would occur if the subsidies were phased out. Our findings also concur with the household survey findings of Wijayapala and Kankanamge (2016) for Sri Lanka, who concluded that electricity subsidies encourage households to use more inefficient equipment such as incandescent lamps. Our research accompanies the work by Burke et al. (2017) on the effect of the concurrent reforms to Indonesia's subsidies for gasoline and diesel on traffic flows on Indonesian toll roads.

The remainder of the paper proceeds as follows. Section 2 provides an overview of Indonesia's electricity sector. Section 3 sets out our models and data. Section 4 presents the results. Section 5 concludes.

2. Indonesia's electricity sector

In 2014 Indonesia was the world's 21st-largest consumer of electricity and, due to high reliance on coal, the 11th-largest emitter of carbon dioxide emissions from the generation of electricity and heat

(IEA, 2017a, 2017b). Indonesia is a relatively small electricity consumer on a per capita basis, however, with use equal to only around a quarter of the world average (World Bank, 2016). Electricity contributed 11% of final energy use in Indonesia in 2015 (in oil equivalent terms). This is much less than the contribution of electricity to final energy use in China (22%). Indonesia has higher reliance on oil-based fuels, solid biomass, and natural gas as final energy sources (IEA, 2017a).

There is substantial geographical variation in electricity use within Indonesia. Java, home to 57% of Indonesia's population, accounted for 72% of electricity sales in 2016 (PLN, 2016a). The household electrification rate is also highest in Java (94%), although with some variation between provinces. Among all of Indonesia's provinces, it is Papua that has the lowest electrification rate, at less than 40% in 2016. The national household electrification rate had risen to 89% as of 2016 (PLN, 2016a), up from 64% in 2009 (PLN, 2009) and 53% in 1995 (Asian Development Bank, 2016). The government has the aim of reaching a national household electrification rate of 97% by 2019 (PLN, 2015a).

The average electricity user in Indonesia faced 81 h without electricity in 2008 (PLN, 2011) as a result of rolling blackouts from a supply system that was struggling to meet demand. This fell to only 5 h in 2015. In 2015 Indonesia scored 4.1 out of 7 for the quality of its electricity supply on a World Economic Forum (2015) survey of business executives, placing 86th among 140 countries. The score was up from 3.5 in 2006. Sambodo (2016, p. 39) nevertheless reports that some regions are in a “power crisis”. Blackouts cause large economic costs (PwC, 2016).

Electricity prices in Indonesia are set by the government, and vary by consumer group and sub-group. Consumers are billed monthly, and face both fixed charges and utilization tariffs. These are typically higher for consumers with larger power connections, measured in volt-ampere (VA). Many consumers face increasing block tariff structures, meaning that they pay a higher marginal per kilowatt hour (kWh) tariff at higher usage levels. Some consumers face a minimum monthly electricity bill; their effective marginal price is zero when electricity consumption is below the minimum threshold. In recent years, consumers have had the option to prepay their electricity bills. Electricity Law No. 30/2009 allows regional differentiation in tariffs; the two small regions of Batam and Tarakan apply their own tariff schedules (World Bank, 2005).

An example of Indonesia's electricity tariff schedules will help. Let us consider residential consumers. As of May 2014, residences with connections of 450 VA (R-1) faced a block pricing schedule, with a monthly fixed charge of 11 IDR per VA of installed capacity and the following utilization tariffs: 169 IDR per kWh for the first 30 kWh during a month; 360 IDR per kWh for units of usage in the 30–60 kWh range; and 495 IDR for each kWh above 60 kWh. There was the option to prepay at 415 IDR per kWh. There are several additional tariff classes for residences with larger connections. Residences with the largest connections (6600 VA or above) faced an unsubsidized tariff of 1352 IDR per kWh, with a minimum monthly payment.

Fig. 1 presents the average annual electricity price paid by each consumer group during 1992–2015, in nominal terms. Changes in the average electricity price are a result of changes in the (a) tariff schedule, (b) composition of electricity consumption by a consumer group, and (c) success of PLN revenue collection.

As can be seen in Fig. 1, electricity tariffs were raised after the Asian financial crisis (AFC) of the late 1990s. This was a time of relatively high inflation, including in PLN's production costs. Tariff schedules were then left unchanged over 2004–2009. These were years of policy uncertainty after the 2002 Electricity Law was ruled unconstitutional. Following the introduction of the new Electricity Law, in 2010 electricity tariffs were again raised for some tariff classes. Recent reforms commenced with Ministry of Energy and Mineral Resources Regulation No. 30–2012, which slated quarterly increases in key tariffs in 2013. Further increases were implemented in 2014 and 2015. A system of

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