ONLINE APPENDIX

A Data appendix

Balance of Payments data: Bank of Japan / Ministry of Finance (http://www.mof.go.jp/english/international_policy/reference/balance_of_payments/ebpnet.htm).

Bank of Japan JGB holdings: Bank of Japan series BJ'MA03021034S.

Bank of Japan real export and import series: Bank of Japan series BP'BP180110001 and BP'BP180110002.

CPI: Japanese Statistics Bureau (http://www.stat.go.jp/english/data/cpi/).

Employed population age 15-64: OECD series LFEM64TT.

Exchange rate – nominal: Bloomberg series USDJPY.

Exchange rate – real: Bank for International Settlements trade-weighted index. We use the broad index including 61 countries. (http://www.bis.org/statistics/eer/.)

Female employment to population ratio: OECD series LFEM64FE (employment) and OECD series LFWA64FE (population).

German real GDP: Fachserie 18, series 1.3 from the Statistisches Bundesamt (https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/NationalAccounts.html).

Government bond yields: Bloomberg series GJGBX where X is the years to maturity.

Hours and employment data: Monthly Labour Survey from the Ministry of Health, Labor and Welfare (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001137658). (Table list is in Japanese, but the tables themselves are in English.)

Inflation swaps: Bloomberg series JYSWIT2, JYSWIT10.

Labor force: OECD series LFACTTTT.

Money market interest rate: IMF, International Financial Statistics.

Money market fund size: Japan: Bank of Japan series FF'FOF_FFAS162A900. Eurozone: ECB Monetary Statistics. U.S.: Federal Reserve H.6. release.

Multifactor productivity: OECD StatExtracts, multifactor productivity table.

Nominal and real earnings: Monthly Labour Survey from the Ministry of Health, Labor and Welfare (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001137658). (Table list is in

Japanese, but the tables themselves are in English.)

Population: For Japan, we use non-seasonally adjusted figures from the Statistics Bureau (http://www.stat.go.jp/english/data/jinsui/2.htm). For the U.S., we use non-seasonally adjusted figures from the Census as downloaded from FRED series POP.

Real GDP and GDP deflator: Official Japanese real GDP data are available from the Japanese Cabinet office (http://www.esri.cao.go.jp/en/sna/menu.html). These data begin in 1994. Prior to 1994, we use the real GDP index from the IMF's International Financial Statistics. We ratio splice this series to the official series in 1994.

Stock market: Nikkei 225 data from Yahoo finance and Topix data from Bloomberg series TPX.

Trade values and quantities: Ministry of Finance, Trade Statistics of Japan.
(http://www.customs.go.jp/toukei/shinbun/happyou_e.htm.)

Unemployment rate: OECD series LRUNTTTT for annual unemployment. The July 2015 number is from Statistics Japan
(http://www.stat.go.jp/english/data/roudou/results/month/index.htm.)

Working age employment: OECD series LFEM64TT.

Working age population: OECD series LFWA64TT. We use non-seasonally adjusted annual data and seasonally adjusted quarterly data. The quarterly data for Japan and Germany end in 2014:Q4. We extrapolate by assuming the working age population changed at the same average quarterly rate from 2014:Q4 to 2015:Q2 as it did between 2013:Q4 and 2014:Q4. For the U.S., data end in 2015:Q1. We impute the 2015:Q2 figure by assuming quarterly growth in 2015:Q2 was the same as the 2014:Q1 to 2015:Q1 average.

U.S. data in table 2: Real GDP: Federal Reserve Bank of St. Louis, FRED database series GDPCA (annual) and GDPC1 (quarterly). Other series as above.

U.S. GDP growth after 1933: NIPA table 1.1.6A.

A.1 Real Imports and Exports Data under Balance of Payments Revision Beginning in 2014, the Balance of Payments Statistics were revised to align with the guidelines of the

International Monetary Fund's *Balance of Payments and International Investment Position Manual*, 6^{th} edition. This led to some reclassification of items between goods and services and between the current and capital account. We know of no quantitative estimate of the effect of this reclassification on the real import and real export figures. But three pieces of evidence suggest that this reclassification does not change the broad story of rising real export and import volumes.

First, an alternative series on real merchandise exports and imports from the Bank of Japan also shows increases in real exports and imports. Between the fourth quarter of 2012 and the second quarter of 2015, it shows real exports rising 6.3% and real imports rising 5.4%. Second, removing the change in real imports and real exports from 2013:Q4 to 2014:Q1 from our calculation, one sees a 9.3% increase in real exports and a 5.3% increase in real imports from 2012:Q4 and 2015:Q2. This adjustment almost certainly provides a lower bound for the actual increase in imports, given the large increase in consumption in 2014:Q1 in advance of the April consumption tax increase.

Finally, although (to our knowledge) no consistent series for real exports and imports exist across 2013 and 2014, Japan does publish a consistent series for the *nominal* value of goods imports and exports for this period. We compare this series to the equivalent nominal series from the national accounts which suffers from the data reclassification problem. The correct data show an increase in nominal goods exports from 2013 to 2014 of 9.2% and of goods imports of 10.3%. The national accounts show increases of 9.6% and 10.5%—reassuringly similar. To our knowledge the equivalent data for services are unavailable. Thus we are left more uncertain about the extent to which the services data may have been affected by reclassification. However, services only account for approximately one-quarter of the total increase in imports from 2013 to 2014, so even substantial changes in the services classification could not explain the large increase in real imports under Abenomics. Furthermore, even excluding the change from 2013:Q4 to 2014:Q1, real service imports rose 18.8% over the entire period of Abenomics, from 2012:Q4 to 2015:Q2.

B A consumption choice model

A household maximizes expected discounted utility subject to a sequence of budget constraints and the accumulation constraint for the storable nondurable good,

$$\begin{aligned}
&\max \mathbb{E} \sum_{t=0}^{\infty} \beta^t [U(C_t, F_t) - v(N_t)] \\
\text{s.t. } \lambda_t: \quad & C_t + \frac{P_t^Z}{P_t^C} Z_t + A_t = A_{t-1}(1 + R_t) + \frac{W_t}{P_t^C} N_t \\
\nu_t: \quad & S_t = (1 - \delta) S_{t-1} + Z_t - F_t \\
\kappa_t: \quad & Z_t \geq 0 \\
\eta_t: \quad & S_t \leq \bar{S} \\
\xi_t: \quad & S_t \geq 0 \\
& F_t \leq (1 - \delta) S_{t-1} + Z_t.
\end{aligned}$$

C_t is non-storable, nondurable consumption bought at price P_t^C, A_t are real bond holdings, R_t is the real interest rate, W_t is the nominal wage and N_t is labor supply. The storable nondurable stock S_t depreciates at rate δ and can be replenished with purchases of the storable good Z_t at price P_t^Z. Consumption of the storable good F_t depletes the stock. We assume that storable good purchases and their stock cannot be negative (no shorting), and that there is a maximum storage capacity $\bar{S}$.

The household takes the sequence of relative prices, real wages and real interest rates as given. The first order conditions for the household are then given by

$$U_{C,t} = \lambda_t \tag{3}$$

$$U_{F,t} = \nu_t \tag{4}$$

$$v'(N_t) = \frac{W_t}{P_t^C} \tag{5}$$

$$\lambda_t = \beta \mathbb{E}[(1 + R_{t+1}) \lambda_{t+1}] \tag{6}$$

$$\nu_t + \kappa_t = \lambda_t \frac{P_t^Z}{P_t^C} \tag{7}$$

$$\nu_t = \beta(1-\delta)\nu_{t+1} + \xi_t - \eta_t \tag{8}$$

In steady-state with $\frac{P_t^Z}{P_t^C} = 1$ and $1+R \geq 1-\delta$ the household will not hold any stock of storable goods, so $\nu = 0$ and $S = 0$. The household will simply purchase storable goods as needed, $F = Z$, because the storing technology is too expensive relative to the return on saving.

However, if the real interest rate $1+R_{t+1}$ temporarily drops below $1-\delta$, then the household will optimally accumulate storable goods up to the capacity constraint $\bar{S}$. This is likely to happen just before a consumption tax increase when prices jump discretely, and when nominal interest rates are zero. In that case $1 + R_{t+1}$ will be temporarily negative because future consumption is more expensive. Further, by shortening the time-horizon (e.g., to days rather than quarters) we can make $1 - \delta$ arbitrarily close to one. Thus, just before the consumption tax causes a discrete price change, the condition $1 + R_{t+1} < 1 - \delta$ is satisfied, and there will be a discrete change in the purchases of durables consumption.

By contrast, if a monetary expansion only smoothly changes the perceived path of real interest rates, the previous argument breaks down. It can be the case that $1 + R_{t+1} > 1 - \delta$ over the entire transition path. Hence, the observed responses of Japanese households to the consumption tax and monetary policy are not inconsistent.