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Burak Sencer Atasoy

Undersecretariat of Treasury, Turkey
burak.atasoy@hazine.gov.tr

Timur Han Gür

Department of Economics, Hacettepe University, Turkey
timurgur@hacettepe.edu.tr

Does the Wagner's Hypothesis Hold for China? Evidence from Static and Dynamic Analyses

Summary: China witnessed an admirable growth performance over the last three decades. It is claimed that such success was achieved by strong support from government expenditures. This study examines the relationship between government expenditures and GDP growth for China within the context of Adolph Wagner's Hypothesis. It covers the most recent time period between 1982 and 2011 and use advanced static and dynamic econometric models to test validity of the Hypothesis for Chinese economy. After determining the stationarity of the series and confirm the existence of the long term relationship between the variables by using the Bounds test approach, we examine the long and short run relationship between government expenditures and GDP using an ARDL model. The ARDL (1, 2) model suggests that 1 percentage point increase in GDP will lead to 1.63 percentage points surge in government expenditures. Finally, we use the Kalman filter to investigate the dynamic relationship between government expenditures and GDP. According to the Kalman filter model, the income elasticity of government expenditures remains between 1.32 and 1.38. Since the elasticity is found larger than 1 in both static and dynamic models, we conclude that Wagner's Hypothesis is valid for China during the 1982-2011 period.

Key words: Wagner's hypothesis, China, Government expenditures, ARDL, Kalman filter.

JEL: E21, E43, E44, E52, E62.

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The relationship between the gross domestic product (GDP) growth and government expenditures is first analyzed by Adolph Wagner (1958). Wagner indicates that government expenditures increase corollary with industrialization process so it is an endogenous factor, or an outcome of growth, but not a component of GDP. Thereafter, this relationship was called "Wagner's Hypothesis" or "The Hypothesis" as we use. According to the Hypothesis, government expenditures increase faster than the GDP during the beginning of industrialization process. Since private sector is reluctant to invest in key areas such as energy, telecommunication, transportation and infrastructure, government has to realize these investments in order to stimulate economy. Governments are also responsible for maintaining the order and safety of community and provide necessary cultural and social services to its citizens. Taking into account all of these, Wagner implies that government expenditures have positive effect on economic growth and increase faster than the GDP growth rates in the beginning of the industrialization process for many countries.

This paper examines the relationship between government spending and economic growth within the context of the Wagner's Hypothesis for China. The study distinguishes itself from the past studies as it covers the recent data between the years of 1982 and 2011, and uses the most advanced econometric techniques to identify the relations between the variables of government spending and economic growth. It also makes a contribution to the literature because, surprisingly only few studies and application are performed on Chinese economy which has witnessed an admirable growth performance over the last three decades. Those studies are also produced inconclusive results on the validity of the Hypothesis.

The paper is organized as follows: the first section reviews both previous and recent studies related to the Wagner's Hypothesis and identifies them by the results obtained from tests and regions covered in the studies. Section two explains the data sources and econometric methodology, and also presents the empirical findings of both static and dynamic models. In the conclusion, the implication of the effects of the government spending on economic growth in China is discussed.

1. Literature Review

The literature on government expenditure and economic growth established right after Wagner's pioneering work. It is started to be tested and modified by many researchers in the following periods. Displacement Effect Theory developed by Alan T. Peacock and Jack Wiseman's (1961) is one of the major contributions to the literature. Peacock and Wiseman implied that government expenditures do not follow a stable growth path. On the contrary, a structural shift in government policies, or extraordinary events like war would cause dramatic leaps in government expenditures.

Some of the early studies in this literature such as Daniel Blot and Michel Debeauvais (1966), Shirshankar P. Gupta (1967), Richard A. Musgrave (1969), Richard M. Bird (1971), Ved P. Gandhi (1971), Irving J. Goffman and Dennis J. Mahar (1971), Nicholas A. Michas (1975), Subrahmanyam Ganti and Bharat R. Kolluri (1979), Arthur J. Mann (1980), Frank Gould (1983), Balbir S. Sahni and Balvir Singh (1984), Morris Beck (1985), Daniel Landau (1986), Johan A. Lybeck (1986), Rotti Ram (1986, 1987), Harold G. Vatter and John F. Walker (1986), employed traditional regression methods and tested the Hypothesis for different periods and economies. They all assumed that series are stationary. Most of these studies found support for Wagner's Hypothesis; however, due to the spurious regression risk, they are not considered "reliable" today.

Beginning in 1990's, use of modern econometric methods such as panel data analysis, causality and co-integration analyses helped to overcome the problem of spurious regression. The recent studies; however, have produced mixed and sometimes contradictory results. Burak Günalp and Timur H. Gür (2002) is one of the first studies that explains the contradictions in results due to set up of the problem and the techniques used in the studies. They apply a panel data analysis to different set ups of government spending and determines the effect on economic growth with time and country specific factors. Dimitrios Sideris (2007), Paresh K. Narayan, Ingrid Nielsen, and Russell Smyth (2008) are some other studies applying similar panel data analyses and new techniques in the literature.

Some of the country and case studies testing validity of the Hypothesis are also worth to mention here. According to Dick Durevall and Magnus Henrekson (2011), about two thirds of the studies in the literature find support for Wagner's Hypothesis based on the country and case studies. Among those, the study of Bird (1971) covers Germany, Sweden, the UK and Japan for the period between 1790 and 1961, and finds strong support for the hypothesis. Richard E. Wagner and Warren E. Weber (1977) test the hypothesis using the data from the post Second World War period, and again find support for 31 out of 34 countries under examination. David Lowery and William D. Berry (1983) prove that Wagner's Hypothesis is valid for the US. Martin T. Bohl (1996) validates the hypothesis for G-7 countries and finds that the hypothesis is valid for 5 OECD countries except the UK and Canada. Les Oxley (1994) tests the hypothesis for the UK over the 1870-1913 periods and finds a unidirectional causality from gross domestic product to government expenditures. Similarly, Ying-Foon Chow, John A. Cotsomitis, and Andy C. C. Kwan (2002) examine Wagner's Hypothesis for the UK over the period 1948-1997 and find robust support for the hypothesis. Serena Lamartina and Andrea Zaghini (2011) use panel co-integration method to examine the relationship between GDP and government expenditures for 23 OECD countries. The authors find that the hypothesis is valid and the elasticity of government expenditures to GDP is higher in poorer countries. Other studies that find support for Wagner's Hypothesis are Franz Hackl, Friedrich Schneider, and Glenn Withers (1993) for Australia, Sohrab Abizadeh and Mahmood Yousefi (1996) for Korea, Anisul M. Islam (2001), Federico Guerrero and Elliott Parker (2007) for the US, Nikolaos Dritsakis and Antonios Adamopoulos (2004), Sideris (2007), Antoniou Antonis, Costantinos P. Katrakilidis, and Persefoni V. Tsaliki (2013) for Greece, and Christoph Priesmeier and Gerrit B. Koester (2012) for Germany.

There are some studies, however, have not found any support for Wagner's Hypothesis in their examinations. Norman Gemmell (1990) tested the hypothesis for 117 countries using data from the 1960-1985 period. Using a non-linear OLS estimation method, the author found no support for the hypothesis. Magnus Henrekson (1993) analyzed the 1861-1990 period for Sweden. He could not find a long run relationship between government expenditures and GDP and posited that support found by other researchers may be spurious. Panos C. Afxentiou and Apostolos Serletis (1996) examined the relationship between government expenditures and GDP for France, Italy, Germany, Belgium, Netherlands and Luxembourg during the 1961-1991 period and found no strong support for Wagner's Hypothesis in any of these countries. Mohammed Ikram Ansari, Daniel V. Gordon, and Christian Akuamoah (1997) investigated the hypothesis for South Africa, Ghana and Kenya and found no support for Wagner's Hypothesis. Márcio I. Nakane and Marcelo Resende (1999) tested the hypothesis for the Brazilian economy during the period between 1948 and 1993. The authors divided the government expenditures into three parts namely consumption, transfer payments, and investment. Using Johansen's co-integration technique, they found no support for Wagner's Hypothesis in any of the three categories. Ferda Halicioglu (2003) tested Wagner's Hypothesis for Turkey over the 1960 to 2000 period. The author found that there is a bi-directional causality between gov-

ernment expenditures and GDP and asserted that the hypothesis does not hold. However, she found support for the augmented version of the Wagner's Hypothesis. Omoke Philip Chimobi (2009) analyzed the Nigerian economy during the 1970-2005 period and found no support for Wagner's Hypothesis. Yakup Kucukkale and Rahmi Yamak (2012) examined the short and long run relationship between economic growth and public expenditures over the 1968-2004 period for Turkey. The authors found no common trend between the variables in the long run. However, they found a strong and bidirectional causal relationship between public investment expenditures and economic growth in the short run.

In studies such as John Ashworth (1995), Kolluri, Michael J. Panik, and Mahmoud S. Wahab (2000), Stella Karagianni, Maria Pempetzoglou, and Soultana Strikou (2002), Tsangyao Chang, WenRong Lui, and Steven B. Caudill (2004), Wahab (2004), Seema Narayan and Narayan (2008), Cosimo Magazzino (2012) the results are ambiguous and the authors found mixed evidence on Wagner's Hypothesis.

As the literature is reviewed, surprisingly we find only few studies examining the Wagner's Hypothesis for China despite the fact China has witnessed an admirable growth performance over the last three decades. Among a few studies, Cotsomitis, Somchai Harnhirun, and Kwan (1996) tested the long run validity of the Hypothesis over the 1952-1992 periods of fourth years, and found some evidence to support in China. Chiung-Ju Huang (2006) examined the long run relationship between government expenditures and GDP relationship for China and Taiwan using data for the 1979-2002 periods. They applied the Bounds test method which pointed out that there is no long run relationship between government expenditures and GDP. By employing Granger causality test they also concluded that Wagner's Hypothesis is not valid for both China and Taiwan. Saten Kumar (2009) also investigated Wagner's Hypothesis for five Asian countries including China. He found that the hypothesis is only valid for Hong Kong but not for Japan, Korea, Taiwan and China.

The next section of this study examines the Wagner's Hypothesis for China with an empirical analysis.

2. Empirical Analysis

2.1 Data and Methodology

Following Peacock and Wiseman (1961), we use government expenditures as the dependent variable and the GDP weighted with Purchasing Power Parity (PPP) as the independent variable. General government expenditures include central, local and state government expenditures. Both series are obtained from the International Monetary Fund (IMF) World Economic Outlook Database October 2012 and the data used for the analysis covers the most recent period of the 1982 and 2011.

Wagner's Hypothesis has been formed in a functional form stated below:

$$lnGOVEXP = f(lnGDP) \tag{1}$$

where, *lnGOVEXP* is natural logarithm of real general government expenditures and *lnGDP* is natural logarithm of real GDP based on PPP. The model we use in this study is $lnGOVEXP_t = \alpha_1 + \alpha_2 lnGDP_t + \mu_t$.

We first examine the stationarity of the series by employing Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. After determining the stationarity of the series, we examine the existence of the long term relationship between variables by using the Bounds test approach developed by M. Hashem Pesaran, Yongcheol Shin, and Richard J. Smith (2001). The advantage of using the Bounds test approach is its practicability. The test provides the opportunity to examine the co-integration relationship between the variables regardless of their order of integration. Therefore, the regressors can be either I(0) or I(1) in this approach (Pesaran, Shin, and Smith 2001). The Bounds test's another advantage is it outclasses the other co-integration approaches in small samples (Narayan and Narayan 2004; Fatih Mangır and Hasan M. Ertuğrul 2012).

Then, we employ an autoregressive distributed lag model (ARDL) to examine the short and long term static relationship between the variables. Furthermore, we employ the Kalman filter which is a dynamic approach to detect the time varying interaction between the variables. By using static and dynamic approaches together, we differentiate our study from previous studies.

2.2 Empirical Results

2.2.1 Unit Root Tests

To investigate the stationarity characteristics of the series we employ ADF (David. A. Dickey and Wayne A. Fuller 1979) and PP (Peter C. B. Phillips and Pierre Perron 1988) tests. The results of the tests are presented in Table 1.

Table 1 Unit Root Test Results

ADF test results			
lnGOVEXP	-0.870	*ΔlnGOVEXP*	-4.618***
lnGDP	-2.752	*Δ lnGDP*	-4.873***
ADF critical values for *lnGOVEXP* and *lnGDP* %1 = -4.32 and %5 = -3.58.		ADF critical values for *ΔlnGOVEXP* and *ΔlnGDP* %1 = -4.32 and %5 = -3.58.	
PP test results			
lnGOVEXP	-0.212	*ΔlnGOVEXP*	-4.217**
lnGDP	-2.369	*ΔlnGDP*	-6.518***
PP critical values for *lnGOVEXP* and *lnGDP* %1 = -4.34 and %5 = -3.59.		PP critical values for *ΔlnGOVEXP* and *ΔlnGDP* %1 = -4.34 and %5 = -3.59.	

Note: ***denotes %1 significance level, ** denotes %5 significance level, * denotes %10 significance level.

Source: Authors' calculations.

The null hypothesis suggests that the series include unit root both for the ADF and PP tests. The calculated *t*-statistics for *lnGOVEXP* and *lnGDP* are less than the critical values in their level forms and greater than the critical values in their first differenced forms. This indicates that both variables are I(1) according to stationarity tests.

2.2.2 The Bounds Test Co-integration Approach

After analyzing the order of stationarity of the series, the co-integration relationship between government expenditures and GDP is examined by employing the Bounds test approach developed by Pesaran, Shin, and Smith (2001). The Bounds test approach allows examining the co-integration relationship between the variables using an Error Correction Model (ECM). Our Unrestricted Error Correction Model (UECM) is formed as follows.

$$\Delta LnGOVEXP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1,i} \Delta LnGOVEXP_{t-i} + \sum_{i=1}^{m} \alpha_{2,i} \Delta LnGDP_{t-i} + \alpha_3 LnGOVEXP_{t-1} + \alpha_4 LnGDP_{t-1} + \mu_t \quad (2)$$

where, *LnGOVEXP* is natural logarithm of real government expenditures and *LnGDP* is natural logarithm of real GDP. In Equation (2), "*m*" depicts number of lags and "*t*" depicts trend variables.

For the *F*-test, we build up our null hypothesis as $H_0 = \alpha_3 = \alpha_4 = 0$ and compare the calculated *F*-statistic with table bottom and upper critical levels in Pesaran, Shin, and Smith (2001). Determining the co-integration relationship depends on the position of *F*-statistics in the table. If the calculated *F*-statistic remains outside the bounds, existence of co-integration can be validated without knowing the order of integration of the regressors. Accordingly, if the calculated *F*-statistic is higher than the upper bound of the table values, we reject the null hypothesis of no co-integration. If the calculated *F*-statistic is lower than the bottom bound of critical values, we conclude that there is no co-integration between the variables. However, if the calculated *F*-statistic remains between the two bounds, we cannot make a certain judgment (Erdal Karagöl, Erman Erbaykal, and Ertuğrul 2007).

For our UECM model, we employ the Akaike and Schwarz information criteria to determine the appropriate lag number. We select the maximum lag number as 8. According to both criteria, the lag number for our UECM model is defined as 1. After that, we examine the co-integration relationship with the Bounds test. Table 2 delineates the Bounds test results.

Table 2 Bounds Test Results

K	***F*-statistic**	Critical value at %5 significance level	
		Bottom bound	Upper bound
1	7.41	6.56	7.30

Note: *k is number of independent variable number in Equation (1). Critical values are taken from Table C1.iii at Pesaran, Shin, and Smith (2001).

Source: Authors' calculations.

According to Table 2, the calculated *F*-statistic is over the upper bound of the critical values, thus the null hypothesis of no co-integration is rejected. Thus, we conclude that a there is a significant long run co-integration between the variables.

2.2.3 The ARDL Model

Now, we are ready to form our ARDL model and examine the long and short run relationship between the variables. Our ARDL model is formed as follows:

$$LnGOVEXP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} LnGOVEXP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} LnGDP_{t-i} + \mu_t. \quad (3)$$

We choose the maximum lag number as 8 and both the Akaike and Schwarz information criteria select the ARDL (1, 2) model. The estimated short and long term coefficients of the ARDL (1, 2) model are illustrated in Table 4.

Table 3 Results of the ARDL(1, 2) Model

Variable	Coefficient	*T*-statistic
lnGOVEXP(-1)	0.860	15.183***
lnGDP	0.596	2.468**
lnGDP (-1)	1.918	4.704***
lnGDP (-2)	-1.093	-4.494***
C	-0.635	-3.468***
Diagnostic checks		
X^2_{BG} *(A)*	0.135 [0.717]	
χ^2_{NORM} *(B)*	0.159 [0.925]	
χ^2_{WHITE} *(C)*	0.352 [0.559]	
X^2_{RAMSEY} *(D)*	1.773 [0.198]	

Note: ***denotes %1 significance level, ** denotes %5 significance level, * denotes %10 significance level. (A), (B), (C), (D) are serial correlation, normality, heteroscedasticity and model specification tests, respectively.

Source: Authors' calculations.

As can be seen from Table 3, there are no serial correlation, heteroscedasticity and misspecification problems in the model and series are normally distributed.

Table 4 ARDL (1, 2) Model's Long and Short Term Parameter Estimations

Estimated long term coefficients using ARDL(1, 2) model		
Variables	Coefficient	*T*-statistic
lnGDP	1.630	14.420***
C	-4.530	-6.661***
Error correction representation for the ARDL(1, 2) model		
Variables	Coefficient	*T*-statistic
dlnGDP	-0.596	-2.468**
dlnGDP1	1.093	4.494***
dC	-0.635	-3.468***
ECT(1)	-0.140	-2.477**

Source: Authors' calculations.

According to long term coefficients of the ARDL model, income elasticity of government expenditures is statistically significant. Our model suggests that 1 percentage point increase in GDP will lead to 1.63 percentage points surge in government expenditures. Since the elasticity is bigger than 1, we conclude that Wagner's Hypothesis is valid for China during the 1982-2011 period by employing static analysis.

Short term coefficients also imply that all variables are statistically significant. The error correction term (ECT(-1)) which is the one period lagged value of error terms derived from the equilibrium relationship points out the elimination rate of the short run disequilibrium in the long run. The ECT coefficient is estimated as -0.14 implying that approximately 14 percent of disequilibrium from the previous year shock will be removed in the current term. To put it in a different way, the system will adjust approximately in 7 years, if a deviation from the long term equilibrium occurs.

2.2.4 Causality Tests

To complement the results gained from the ARDL model, we analyze the direction of causality between government expenditures and GDP by applying causality test. First we run the traditional Granger causality test. Then we supplement the Granger causality test results with the approach suggested by Hiro Y. Toda and Taku Yamamoto (1995).

The Granger causality test was first developed by Clive W. J. Granger (1969) and became extremely popular in economics literature. It examines whether one time series is helpful in predicting another. Granger's test is the most popular test for causality; however there are other methods to examine the causality between variables. Nikola Gradojević and Eldin Dobardžić (2013) and Gradojević and Camillo Lento (2015) exhibit examples for different methods.

The Granger causality test runs the following regressions:

$$LnGOVEXP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} LnGOVEXP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} LnGDP_{t-i} + \mu_t \quad (4)$$

$$LnGDP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} LnGDP_{t-i} + \sum_{i=0}^{n} \alpha_{2i} LnGOVEXP_{t-i} + \varepsilon_t. \quad (5)$$

The null hypotheses posited by the Granger causality test are "*LnGDP* does not Granger-cause *LnGOVEXP*" for the Equation (4) and "*LnGOVEXP* does not Granger-cause *LnGDP*" for the Equation (5), respectively. Having an *F*-statistic above the critical value causes a rejection of the null hypothesis. We use first differenced series for both government expenditures and GDP to avoid spurious regression risk.

$$H_0 = \alpha_{21} = \alpha_{22} = ... = \alpha_{2i}. \quad (6)$$

Table 6 presents the results of the Granger causality test. The optimal lag length is selected as 2 by the Schwarz, Akaike and Hannan-Quinn information crite-

ria. Accordingly, we cannot reject the null hypothesis of "*LnGOVEXP* does not Granger-cause *LnGDP*". However, we can reject the null hypothesis of "*LnGDP* does not Granger-cause *LnGOVEXP*". Therefore, we find that there is a unidirectional causality and it runs from GDP to government expenditures.

Table 5 Optimal Lag Length Selection for the Granger Causality Test

Lag	Akaike information criterion	Schwarz information criterion	Hannan-Quinn criterion
0	0.684	0.781	0.712
1	-8.250	-7.959	-8.166
2	-9.103*	-8.584*	-8.928*
3	-8.951	-8.274	-8.756
4	-9.067	-8.232	-8.852

Source: Authors' calculations.

Table 6 The Granger Causality Test Results

Null hypothesis	***F*-statistic**	***p*-value**
LnGOVEXP does not Granger-cause *LnGDP*	2.267	0.687
LnGDP does not Granger-cause *LnGOVEXP*	17.115	0.002

Source: Authors' calculations.

In order to supplement the results gained from the Granger causality test, we also use the approach developed by Toda and Yamamoto (1995). Toda and Yamamoto's approach is quite handy as it is unit root robust and can be applied irrespective of the co-integration between variables. This method involves adding additional lags of the variables to the VAR which are not restricted in the traditional Granger causality tests and uses a modified Wald test statistic to gauge the significance of the parameters. In this context, a VAR($s+d_{max}$) model is estimated where s is the optimal lag length and d_{max} is the maximum level of integration. This test has an asymptotic χ^2 distribution.

As can be seen from Table 7, Akaike, Schwarz and Hannan-Quinn information criteria again point out to an optimal lag length of 2. Since both *LnGOVEXP* and *LnGDP* are I(1) and the optimal lag length is 2, we estimate a VAR(3) model in the levels of these series. The results of the Toda-Yamamoto procedure are summarized in Table 8. Accordingly, the null hypothesis of "*LnGOVEXP* does not Granger-cause *LnGDP*" cannot be rejected. However, the null hypothesis of "*LnGDP* does not Granger-cause *LnGOVEXP* can be rejected since the calculated *chi-square*-statistic is larger than the critical value. We conclude that there is a unidirectional causality and it runs from GDP to government expenditures. The results of the Toda-Yamamoto approach support the results gained from the traditional Granger causality test.

Table 7 Optimal Lag Length Selection for the Toda-Yamamoto Approach

Lag	Akaike information criterion	Schwarz information criterion	Hannan-Quinn criterion
0	-7.639	-7.542	-7.612
1	-8.695	-7.895	-8.614
2	-8.961*	-8.403*	-8.718*
3	-8.816	-8.133	-8.626
4	-8.444	-8.084	-8.511

Source: Authors' calculations.

Table 8 Toda-Yamamoto Causality Test Results

Null hypothesis	***F*-statistic**	***p*-value**
LnGOVEXP does not Granger-cause *LnGDP*	0.923	0.630
LnGDP does not Granger-cause *LnGOVEXP*	18.751	0.0001

Source: Authors' calculations.

2.2.5 The Kalman Filter Approach

Following Andrew C. Harvey (1989), we use the Kalman filter to investigate the dynamic relationship between government expenditures and GDP. The Kalman filter first derived by Rudolf E. Kalman (1960) and started to be used as a computational tool in economics starting from 1970s. In the state-space model, it is possible to specify more complex dynamic error structures (Robert F. Engle and Mark W. Watson 1985).

The Kalman filter is an algorithm for sequentially updating a linear projection on the vector of interest and helps to extract signals to write down a model linking the unobserved and observed variables in a state-space representation (Nicolas A. Cuche-Curti and Martin K. Hess 1999). In the Kalman filter approach, we have a model that has "state vectors", (α) which are meant to depict the current state of the system. However, typically it is not possible to observe them. Therefore, we use another input called the "observed variables", y . This input connects the state vector to the vector that includes the observed variables.

A linear state-space of the dynamics of an equation can be showed as follows:

$$y_t = c_t + Z_t\alpha_t + \varepsilon_t \tag{7}$$

$$\alpha_{t+1} = d_t + T_t\alpha_t + v_t \tag{8}$$

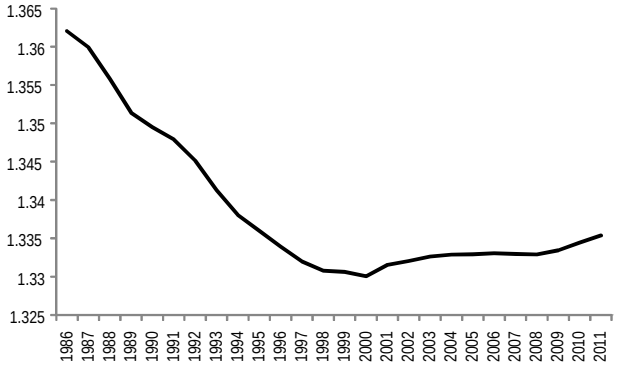
where c_t, Z_t, d_t and T_t are adaptable vectors and matrices, α_t is a $4x1$ vector of unobserved state variables, and ε_t and v_t are vectors of mean zero, Gaussian disturbances. As shown in Equation (8), unobserved state vector α_t is assumed to change over time as a first-order vector auto-regression (Mangır and Ertuğrul 2012). In the Kalman filter methodology, the parameters are estimated recursively by updating the estimation with every additional observation (Gary Koop and Simon M. Potter 2007).

The dynamic specification used in our study is represented below.

$$\Delta GOVEXP_t = a_0 + a_{1,t}\Delta GDP_t + \varepsilon_t \quad (9)$$

$$a_{i,t} = a_{i,t-1} + v_{i,t}\,. \quad (10)$$

Figure 1 illustrates the results of time varying parameter estimates for the 1986-2011 period. According to the Kalman filter model, the income elasticity of government expenditures remains between 1.33 and 1.36 and Wagner's Hypothesis holds. This result is consistent with the results derived from the static ARDL model. GDP has a positive and incrementally decreasing effect on government expenditures during the 1986-1999 period and starting from 2000, the coefficient of GDP begins to increase. This result is consistent with China's accession to the World Trade Organization (WTO) in 2001 and opening up more to the global economy. It can be inferred that an increase in the level of integration to the world economy also stimulated the income elasticity of government expenditures in China.



Source: Authors' calculations.

Figure 1 Kalman Filter Results

3. Conclusion

The Chinese economy recorded 10 percent average GDP growth rate during the 1980-2011 period, while global average was only 3.4 percent. Such admirable growth achieved in the world's second largest economy needed a sufficient explanation for sure. For this reason this study examined the high growth rates in a socialist - market economy of China and tests the Wagner's Hypothesis to detect the role of public sector in economic performance over the last thirty years in particular. We believe that the study fills the gap in the literature because works on the fastest-growing economy of the world are few and the results obtained were not conclusive in the past studies. Using a dynamic and an advance econometric techniques, this study distinguishes itself from the others and contributes to the literature. In the analysis, we first examine the stationarity of the series, and employ ADF and PP tests. According to ADF and PP tests, both series are found to be integrated with degree

one. After determining the stationarity of the series, we examine the existence of the long term relationship between variables by using the Bounds test approach. Developed by Pesaran, Shin, and Smith (2001), the Bounds test approach allows examining the co-integration relationship between the variables using an ECM. According to the test results, the calculated *F*-statistic is over the upper bound of the critical values, thus the null hypothesis of no co-integration is rejected. Thus, we conclude that a there is a significant long run co-integration relationship between the variables. After the co-integration analysis, we examine the static long and short run relationship between government expenditures and economic growth using an ARDL model.

According to long term coefficients of the ARDL model, income elasticity of government expenditures is found statistically significant. Our ARDL (1, 2) model, therefore, suggests that 1 percentage point increase in GDP will lead to 1.63 percentage points surge in government expenditures. Since the elasticity is larger than one, we conclude that Wagner's Hypothesis is valid for China during the past 30 years of 1982 and 2011 under static analysis. Short term coefficients also imply that all variables are statistically significant. The ECT(-1) which is the one period lagged value of error terms derived from the equilibrium relationship points out the elimination rate of the short run disequilibrium in the long run. The ECT coefficient is estimated as -0.14 implying that approximately 14 percent of disequilibrium from the previous year shock will be removed in the current term. To put it in a different way, the system will adjust approximately in 7 years, if a deviation from the long term equilibrium occurs.

Finally, we use the Kalman filter to investigate the dynamic relationship between government expenditures and GDP. According to the Kalman filter model, the income elasticity of government expenditures remains between 1.33 and 1.36 indicating that Wagner's Hypothesis holds. This result is consistent with the results derived from the static ARDL model. GDP has a positive and incrementally decreasing effect on government expenditures during the 1986-1999 period. Starting from the year 2000, it is seen that the coefficient of GDP begins to rise. This result is consistent with China's accession to the WTO in 2001 they leads to integration of Chinese economy to the global economy. It can also be inferred that an increase in the level of integration to the world economy also stimulated the income elasticity of government expenditures in China.

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