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# **THREE ESSAYS ON MONETARY POLICY AND ECONOMIC GROWTH IN CHINA**

Peng Wang

Thesis submitted to the  
Faculty of Graduate and Postdoctoral Studies  
In partial fulfillment of the requirements  
For the PhD degree in economics

Department of Economics  
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## Abstract

*This dissertation consists of three essays that examine various important macroeconomic issues that are of concern to the Chinese economy. The analysis that supports the empirical work is inspired by post-Keynesian theory. The first chapter presents the mechanism of endogenous sterilization by extending the theory of demand-led money supply to the case of China. This view of money is confirmed by the fact that foreign reserves are not cointegrated with base money, meaning that there is no long-run relationship between foreign reserves and the supply of base money, whereas foreign reserves are long-run related with the claims of the central bank and the amount of bonds issued by the central bank.*

*The second chapter outlines Kaldor's laws and tests for the contributions of the manufacturing sector to labor productivity and overall output growth using the panel dataset of 29 Chinese regions during the period of 1986-2007. Empirical findings, taking advantage of spatial panel econometric techniques, provide significant support for the Kaldorian thesis, while the incorporation of spatial autocorrelation improves the performance of empirical models compared to traditional ones.*

*The third chapter analyzes the relationship between functional income distribution and Chinese economic growth from 1993 to 2007. Based on a demand-driven macroeconomic framework, there is a possibility of either profit-led or wage-led demand regime depending on the total effects of changes in the profit share on all components of final demand. Our results suggest that the Chinese economy presents a profit-led nature both for all 29 regions and for the coastal regions. We also find that while the expansion of interregional and international trade plays an important role, it is investment expenditure that determines the profit-led pattern of economic growth.*

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# Introduction<sup>1</sup>

The rise of China since the beginning of the economic reform in 1978 has been astonishing. In 1978, China's GDP only ranked 10<sup>th</sup> in the world, while in 2008, it has bypassed Germany to become the third largest economy, and is forecasted to overtake Japan by 2010. China's world GDP contribution has shifted from 1.8% in 1978 to 6.0% in 2008. The annual real GDP growth rate during the last three decades is 9.8% which is higher than that of 6.1% between 1953 and 1978 and higher than the world average rate of 3.0%. Standards of living in China have been drastically improved as well. China's per capita income has grown from \$190 in 1978 to \$3,180 in 2008. According to the standards of the World Bank, China has turned to a middle-low income country from a low-income one.

In fact, China's economic take-off has been far from smooth or noiseless. The growth rate dropped to 3.8% in 1990 because of people's confusion about the economic and political beliefs deriving from the violent collapse of the Soviet Union. The political chaos had also destabilized foreign investors' confidence until Deng Xiaoping reasserted the market economic policy on his second inspection tour of South China in 1992. Now China is experiencing another economic slowdown. The World Bank has cut China's GDP growth forecast from 7.5% to 6.5% in 2009 because exports are plunging as a result of the global recession. This harsh situation has raised a controversy among Chinese economists. The focus of the debate is about how the

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<sup>1</sup> Statistics in this section are obtained from the National Bureau of Statistics of China.

central bank should deal with the huge foreign reserves and how the central government may stimulate domestic demand and reduce inflationary pressures at the same time, so as to achieve a sustainable economic growth.

As an open economy with a fixed or managed-floating exchange rate, China has accumulated a vast amount of foreign reserves. Neoclassical authors argue that rising foreign reserves will generate money growth and produce high inflation, as described by the well-know Mundell-Fleming model (Mundell, 1963). According to Mundell's "trilemma", monetary authorities implement monetary policies by means of adjusting the money supply, which is endogenous and supply-determined in the fixed exchange rate regime. A recent study contributed by Glick and Hutchison (2008) supports Mundell's view and claims to demonstrate the inefficiency of the Chinese central bank's sterilization policy. However, post-Keynesian authors provide a different view. They believe that a rise in foreign reserves can be automatically offset by negative changes in claims of the central bank, or by positive changes in other liability items. We may call this "endogenous sterilization operation". Short-term interest rates are exogenously determined by the central banks which do not, nor can they, control any monetary aggregates. The money supply is credit-driven and demand-led (Lavoie, 2001). In this sense, the Chinese central bank should not fear the impact of rising foreign reserves on exchange rates, inflation or the independent monetary policy because those effects will be neutralized by endogenous sterilization.

Increasing regional disparities and income inequalities are also what the central government is concerned about since they will lead to social instability and thus a

laggard economic growth. Kaldor (1989) attributes regional inequality to the unbalanced growth of the manufacturing sector and the induced productivity differences to a process of cumulative causation. He has developed three laws in attempting to explain economic growth. The first law says that manufacturing is the engine of economic growth. The second law, also known as Verdoorn's law, implies that faster manufacturing growth or industrial growth will cause faster productivity growth through the effect of increasing returns to scale. His third law states that the overall productivity growth is positively associated with manufacturing growth and negatively associated with non-manufacturing employment. In light of Kaldor's laws, the central government should adopt the following development policies: "first, economic development requires industrialization; second, this in turn presupposes an 'agriculture revolution'; third, entering into the global market with a temporary stage of protection for newly established industries; fourth, this must be accompanied by export-led growth policies" (Targetti, 2005)<sup>2</sup> These policies have been implemented by the Chinese government successively, apparently contributing to the economic miracle in China.

Another important study relevant to the issue of income inequalities is to evaluate the relationship between distribution and economic growth. Neoclassical authors support policies of wage moderation and argue that squeezing wages is the best way to reduce unemployment and stimulate economic growth (Calmfors, 1995; Blanchard, 2004). Nevertheless, Bhaduri and Marglin (1990) argue that a rise in the wage share

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<sup>2</sup> See Targetti, F. (2005): Kaldor's contribution to development economics, *Economic Development and Change*, [http://www.ferdinandotargetti.it/articoli/art/1\\_4.htm](http://www.ferdinandotargetti.it/articoli/art/1_4.htm).

not only causes higher labour costs and depress entrepreneurs' profits and their investments, but also stimulates consumption demand by providing more purchasing power to households, as long as economic growth is demand-driven. Taking into account international trade, one may find that the effect of the profit share on net export is ambiguous depending on the cause of the change in the profit share (Hein and Vogel, 2008). As a result, whether aggregate demand is profit-led or wage-led depends on which effect prevails.

We will discuss all these controversial questions regarding the Chinese economy in light of various economic theories and empirical evidence. By analyzing the Chinese macroeconomic performance during the last three decades, this dissertation aims to provide empirical exercises in post-Keynesian theory, and provide viable suggestions for China's economic policies.

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# Chapter 1: Endogenous Sterilization: The case of the Chinese Central Bank

## 1.1 Introduction

As is well-known, the Mundell-Fleming model was the first model to describe both the real and money sides of a small open economy. Based on the IS/LM model of the closed economy, it extends the theory to the interaction between nominal exchange rates, monetary policy and output. The mechanics of the model is divided under the possibility of two regimes. Under the flexible exchange rate regime with perfect asset substitution and perfect capital mobility, monetary policy is the only effective economic instrument while fiscal policy plays no role in the economy. In the fixed exchange rate regime, under similar conditions, it is said that monetary policy is ineffective. Any attempt by the central bank to increase the money supply by raising the supply of reserves will lead to lower interest rates, which will lead to a loss of foreign reserves. In other words, there will be no change in the money supply, and thus no long-run effect on output and employment. This means that monetary policy in this case is not effective, as claimed by Mundell (1963, p.479), “the central bank has simply traded domestic assets for foreign assets”. In addition, when there is a balance of payments surplus, the money supply tends to increase, as the central bank must purchase foreign reserves and issue domestic money. Hence, eventually, output or inflation rise, thus leading to a rise in money demand and a reduction in exports,

and in the end the balance of payments surplus gets wiped out, and external equilibrium is brought back. In addition, he was pessimistic about the effect of sterilization intervention, claiming “golden sterilization policies make no sense in a world of fixed exchange rates and perfect capital mobility and will ultimately lead to the breakdown of the fixed exchange system. ... But sterilization operation is analogous to trying to prevent the water from spilling out, even though the sink is full and water is still pouring out of the tap.” (Mundell, 1963, p.485)

Various studies show that the Mundell-Fleming analysis is still highly fashionable, being widely embraced not only by Neo-Classical economists but also by New Consensus economists: “Under a fixed exchange rate, the central bank adjusts the money supply to keep the nominal exchange rate constant.”(Romer, 2006, p.261-2). Such statements also appear in textbooks written by Mankiw (2002), J.B. Taylor.(2004) and Walsh (1998). Obstfeld and Rogoff (1995. p.5) discussed the difficulties of defending fixed exchange rate with the expansion of global capital markets by analyzing the interaction between the commitment and credibility of central banks, and they claimed that sterilized intervention operations “are largely smoke and mirrors” which “can do little, if anything, to break the tight link between monetary policy and the exchange rate.” Goodfriend (2008) argued sterilization would be fragile because higher costs induced by the rise in interest rates encourage attacks by international speculators

Some economists have questioned the arguments of the Mundell-Fleming model in the case of the fixed exchange rate regime, underlining the role of the reflux

principle in open economies. When commercial banks dispose of money reserves that they would not like to hold, these additional reserves can be extinguished by the reimbursement of previously accumulated debt vis-à-vis the central bank. In other words, if we suppose the economy is on a fixed or a pegged exchange rate, and that the economy is running a balance of payment surplus, there will be no increase in the size of the balance sheet of the central bank. On the contrary, two opposite changes usually will occur on the asset side of the balance sheet of the central bank. While foreign reserves will increase, the total claims on the domestic economy will be automatically compensated by the same amount. This is the fundamental rationale of the “compensation principle”. This phenomenon was endorsed by many French economists and central bankers (Berger, 1972a, 1972b; Le Bourva, 1992) when they noted how the Banque de France dealt with the accumulation of foreign reserves in the 19<sup>th</sup> century. This analysis is also confirmed by statistics in the gold standard periods of 1880-1913 and 1922-1938. (Nurkse, 1944; Bloomfield, 1959).<sup>3</sup> These studies all reach the same conclusion: “Despite the wide fluctuations in gold reserves, the variations in the monetary base and the money supply were quite limited.” (Lavoie and Rodriguez, 2006, p.6) Thus, as noted by Lavoie (2001, p.229), “With fixed exchange rates, sterilization occurs automatically. Despite the huge increase in foreign reserves, there will be no change in the overall size of the assets of the central bank, and hence no change in the monetary base or in the supply of money.” Taking the case of the Canadian central bank, he also claims that “The increase in foreign reserves is

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<sup>3</sup> Cited from Lavoie and Rodriguez (2006)

thus once more fully compensated, either by a reduction in domestic credit, or through a shift in government deposits from the accounts of commercial banks to the government account at the central bank, thus wiping out the banks' excess settlement balances.” (Lavoie, 2006, p.30)

The endogenous sterilization introduced in this paper can be said to be an extension of the “compensation principle”, incorporating movements of elements on the liability side of the balance sheet of the central bank besides the offsetting movements on the asset side. This happens because economies do not fully behave like overdraft economies<sup>4</sup> as they found it more difficult to compensate for changes in foreign reserves by simply reducing total claims to the domestic economy, due to the huge size of these changes in foreign reserves. In fact, a combination of instruments is usually used to implement the sterilization process. Besides the reduction in the credits to the domestic economy on the asset side, there will be increases in central bank bills<sup>5</sup> or government deposits on the liability side of the balance sheet of the central bank, thus sterilizing the growing amount of foreign assets held by the central bank. In contrast to Mundell's “inconsistent trinity”, the central bank is able to maintain a fixed exchange, perfect capital mobility and an independent monetary policy simultaneously, especially if the country has a balance of payment surplus. For the sake of explanation, we divide this process into two phases. In the

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<sup>4</sup> Firms must borrow from commercial banks and in turn commercial banks borrow from the central bank. This is the definition of an overdraft economy.

<sup>5</sup> Issuing central bank bills has been the main instrument to accomplish monetary policy for many central banks. They are provided to commercial banks by the central bank to adjust the amount of their excess reserves. Central bank bills are predominately short-term usually with a 3-month maturity and their yields are similar to those of government securities.

first phase, the central bank is forced to purchase foreign reserves by expanding the money base to maintain the level of exchange rate, which leads to a downward pressure on interest rates. In the second phase, the money expansion is absorbed either by a reduction in government securities or an increase in central bank papers. This would provide an upward pressure on interest rates so that central bank can target rates of interest and the exchange rate at their original levels with perfect capital mobility. This sterilization process is endogenous because all elements of the balance sheet move automatically along with changes in foreign reserves, except the supply of the monetary base, to keep interest rates exogenous. As claimed by Godley and Lavoie (2005, p.251), it shows “how ‘sterilization’ would occur automatically and endogenously, being the consequence of the central bank decision to keep interest rates at a given level, which is how central banks function in the real world.” However, this endogeneity is not a reflection of the passive response of central bank. Instead, central bank actively intervenes in the exchange and financial markets because of its desire to maintain interest rates and the exchange rate at their target levels.

As noted above, Mundell’s trilemma has been falsified under the circumstance of a balance of payment surplus. Foreign reserves are free to keep rising with the target level of the interest rate, with a constant exchange rate and with perfect capital mobility. Nevertheless, this power of central bank seems to be weakened if the economy is subject to a balance of payment deficit. In this case, the central bank is also able to target interest rates and the exchange rate as long as foreign reserves do

not get exhausted. In other words, the central bank cannot suffer from persistent losses of foreign reserves for a long period of time. This impotence of central banks is also confirmed by Frenkel (2008, p. 2): “Certainly, the trilemma is generally invalid in deficit situations. Under conditions of excess demand in the foreign exchange market, even powerful Central Banks have an intervention capacity that is ultimately limited by the availability of foreign reserves. Consequently, under conditions of excess demand for foreign currency even those central banks are incapable of having an exchange rate target without affecting the interest rate. But there is no symmetry between situations of deficit and surplus in the balance of payments. In one case the trilemma is valid while in the other it is not.”

However, this situation does not imply the validity of the Mundell-Fleming analysis and it is unnecessary for central banks to abandon the fixed exchange rate regime. Government interventions or fiscal policies that encourage exports and reduce imports would be helpful to improve the imbalance condition, such as restrictions of demand suggested by Godley and Lavoie (2005) or strong protective tariffs. Such an argument was also put forward by L. Taylor, who used both accounting tables and mathematic models to conclude that “the Mundell-Fleming duality principle is invalid, ..... the trilemma per se makes no sense” (L. Taylor, 2004, p. 316); “(Because of sterilization), the exchange rate regime – fixed, floating in forward markets, or something in between – has no impact in principle on the ability of the monetary authorities to control central bank assets, even with capital mobility” (L. Taylor, 2004, p. 342), although he admitted that those countries with balance of

payment deficits “have far less room to maneuver”.

The purpose of the present chapter is to analyze the endogenous sterilization approach by studying the case of the Chinese economy and by providing some empirical evidence. In the next section, I develop the elements of the Mundell-Fleming approach in more detail, focusing on Mundell’s assertion that money is endogenous and supply-determined in the fixed exchange regime. In the third section, I briefly introduce endogenous sterilization, which is also named the “compensation thesis”, and explain the mechanism of the endogenous sterilization approach, based on the reflux principle, which questions the validity of the Mundell-Fleming analysis under the fixed exchange rate regime. The fourth section gives the example of the Chinese central bank, discussing controversies among Chinese economic scholars over the effects of the endogenous sterilization by looking into the balance sheet of the Chinese central bank. The fifth section presents a new cointegration analysis when the sample size is small. This has been called the bootstrapping cointegration method. We use it to test the relationship among some key elements of the balance sheet of the Chinese central bank and interpret the economic meaning of the empirical results.

## **1.2 The neoclassical Mundell-Fleming model**

The Mundell-Fleming model was set forth by Robert Mundell (1963), extending the neoclassical synthesis analysis of business cycle to an open economy with perfect capital mobility. One of the enduring contributions of Mundell’s work has been the

explorations of monetary dynamics with international financial relations, trying to figure out how international payment imbalances are equilibrated. Previous arguments of relevance were based on the “price-specie-flow” mechanism described by David Hume (1987), who was one of the initial supporters of the quantity theory and of the neutrality of money.

Assuming away sterilization, the expansion of the money base due to a balance of payments surplus causes a decline in interest rates which would induce both a rise in domestic prices, resulting in exports to decrease and imports to increase, and an inflow of capital. Thus, this process of adjustment induced by prices will last until the economy restores its balance of payments equilibrium. As shown in Table 1.1, there is then a one-to-one relationship between the size of foreign reserves on the asset side and the monetary base. Thus, the rise in foreign reserves induces an increase of an equal amount in the base money supply, thus leading to a higher money supply and lower interest rates, and higher domestic prices. But this description certainly oversimplifies the current monetary system.

Table 1.1: Hume’s balance sheet of the central bank

Assets	Liabilities
Foreign reserves	Reserve Money

Mundell (1961) described another representation of this adjustment process under the Keynesian assumption of wage and/or price rigidity instead of the classical

case of price flexibility. In this framework, the increased money supply induced by the external surplus leads to lower interest rates and thus an outflow of capital. Meanwhile, lower interest rates stimulate the rate of investment and output, which in turn results in an increase in imports. As a result, the capital outflow and the increase in imports encourage an external deficit and a money contraction, which is called the “income-specie-flow” mechanism of Keynes, analogous to the “price-specie-flow” mechanism. As noted by Mundell (1961, p.222), “The difference between the classical and Keynesian cases is that the temporary change in money income is effected through variations in the price level in the one case and adjustments in the level of output in the other case. In both cases, the original level of prices and output is restored.”

As a matter of fact, the persistent post-war payments imbalances seemed to contradict this argument. Taking into account the sterilization effect, Mundell (1961) claimed that it was the widespread use of sterilization that stopped external payments from achieving their balance level: “It is the variability of the latter ratio (gold and foreign exchange reserves to cash) that ruptured the link between the balance of payments and the money supply and gave rise to the ‘disequilibrium system’.” (Mundell, 1961, p.223) To stabilize the money income and economic situation, “many countries may therefore remain in external disequilibrium for a considerable period of time, taking no explicit policy steps to correct the situation, and preventing the adjustment process from having its natural corrective influence.” (Mundell, 1961, p.228)

The Mundell-Fleming model (1963), extending the analysis of his work in 1961, has been said to be an indirect version of the “price-specie-flow” model. Different from Hume’s framework, Mundell assumed the economy with rigid prices and incorporated sterilization in his model. Apart from supporting Hume’s conclusion, he continued to be pessimistic about sterilization policies, arguing that this intervention by the central bank will distort the automatic adjustment of the domestic economy.

Table 1.2: Mundell’s balance sheet of the central bank

Assets	Liabilities
Foreign reserves	Reserve Money
Claims on domestic economy	

When the central bank doesn’t neutralize the foreign exchange, the representation is similar to Hume’s “price-specie-flow” mechanism, which follows the perfectly automatic adjustment process. If there is a foreign exchange surplus, “foreign exchange reserves accumulate by the full amount of the increased cash reserves needed by the banking system to supply the increased money demanded by the public as a consequence of the increase in income.” (Mundell, 1963, p.480) The reason for which monetary policy loses its force under the fixed exchange regime is that any downward effect on interest rates caused by an expansionary monetary policy, in the form of open market purchases of domestic assets, is counteracted by the upward effect on interest rates arising from the capital outflow. Income remains constant due

to the unchanged interest rate.

The falling pressure on the exchange rate caused by the capital outflow can be prevented by the central bank's intervention, selling foreign assets and purchasing domestic money. Fiscal policy is effective in this case because government spending increases households' income and their demand for money, causing a rise in the interest rate. The induced capital inflow leads to an external surplus, foreign asset purchases by the central bank and an expansion of base money. Thus, output, taxes and savings all increase in this case. This famous intrinsic incompatibility of perfect capital mobility, fixed exchange rate and monetary policy has been known as the "Inconsistent trinity" or "trilemma".

When sterilization policy is taken into account, for instance when the central bank sells securities as it purchases foreign reserves as long as there is a balance of payment surplus, it is said that interest rates tend to rise, thus inducing capital inflows and further sterilization to keep the fixed exchange rate, thus putting added pressure on interest rates. However, during the process, interest rates are prevented from rising due to the capital inflow and the money income is constant. Therefore, sterilization policy is said to be ineffective while leaving the system more imbalanced as the process repeats itself at an accelerating rate. "...open market operations (monetary policy) lead to an inconsistent and over-determined result. ... The sterilization procedures merely perpetuate the self-generating process until exchange reserves are exhausted, or until the world level of interest rates falls." (Mundell, 1963, p.481)

This argument has been regarded as the elementary workhorse of international

macroeconomics. "... each exchange by the central bank of dollars for foreign currency has the effect of changing the home country's stock of 'high-powered money'. And as most readers will know from their study of money and banking , changes in high-powered money tend strongly to induce changes — approximately equal percentage changes — in the stock of money ..." (McCallum, 1996, p.137). Obstfeld (1982, p.45) provided empirical studies of the offset coefficient measuring the effect of domestic credit expansion on the capital account, taking the case of West Germany. He suggested sterilization might be a feasible temporary instrument, but doubted its long term validity.

Calvo (1990, p.1) has also pointed out that sterilizing the capital inflow by issuing a huge amount of domestic debt may increase the interest rate and thus the fiscal deficit, especially in a country with a large debt, resulting in the instability of the economy. Craig and Humpage (2001, p.5) from the Cleveland Fed suggested that "if one believes that intervention always acts as a monetary-policy signal, then it has created as much uncertainty about monetary policy and confusion about the strength of the Committee's commitment to price stability than it has cleared away". This frequent view was also offered by an economist from the Bank of Canada, who said "there has been a marked increase in the use of non-market methods, which may have undesirable consequences of financial stability over the medium term." (Lavigne, 2008, p.19) Such opinions are summarized by a well-known neo-classical economist: "It is the case, then, that central bank interventions in the foreign exchange market may not affect the home country money stock if they are sterilized. Most research on

this issue has indicated, however, that the effects on exchange rates of sterilized market interventions are both weak and short-lived. Thus a central bank can keep its nation's exchange rate fixed only by engaging in non-sterilized interventions."(McCallum, 1996, p.138)

### **1.3 The endogeneity of the money supply and the endogenous sterilization mechanism**

The endogenous sterilization process in a fixed exchange regime can be explained in the following steps. Firms apply for loans from banks to purchase equipments and labor services, based on the assumption of an overdraft economy. When they earn profits, or receive capital inflows from abroad, they exchange the foreign currency for the domestic currency and deposit it in banks, then pay back their bank debts. As a second step, commercial banks exchange this foreign currency at the central bank, receiving the additional base money, which can be used either to decrease their debts towards the central bank or to decrease their demand for new reserve requirements. As Lavoie (1992, p. 190) says, "The increase in the amount of base money obtained through foreign sources is compensated by a decrease in the amount of base money obtained through domestic sources. This is the origin of the expression 'compensation'." In fact, in an overdraft economy, the growing liquidity caused by the balance of payment surplus puts downward pressures on the prices of government bonds and central bank bills. The task of the central bank is to sell bonds to commercial banks and thus keep the interest rate constant. As presented in Table 3,

there are more than three items in the balance sheet, and hence more possible instruments of sterilization.

Table 1.3: Post-Keynesian balance sheet of the central bank

Assets	Liabilities
Foreign reserves (FR)	Reserve Money (MB)
Claims on domestic economy (Claim)	Central bank bonds (Bond)
	Government Deposits (GD)
	Others (OT)

Based on the balance sheet of the central bank, the relationship between elements on the assets side and those on the liabilities side can be shown by the following specification:

$$FR + \text{Claim} = MB + GD + \text{Bond} + OT$$

However, if endogenous sterilization theory holds, the money supply, or more specifically the monetary base (MB), is expected to be excluded from the relationship and the above equation would be specified as:

$$FR + Claim = GD + Bond + OT^6$$

An increase in foreign reserves can thus be compensated, or endogenously sterilized, by a reduction in advances to domestic economy or by an increase in government deposits and central bank bonds. This financial intervention will be implemented by the central bank automatically to maintain the level of interest rates. If there is a balance of payment surplus, commercial banks, after having acquired foreign currencies from export firms, will sell these to the central bank. Meanwhile, commercial banks wind up with excess reserves. They will either decrease their debt vis-à-vis the central bank or purchase central bank or government securities with their excess balances. Any other discrepancy would be absorbed by changes in OT. Central bank bonds are provided to those who demand them at the target interest rate. This process, different from the automatic adjustment mechanism of Mundell-Fleming analysis, will retain the position of external surplus without any negative implications.

The endogenous money supply, on the liability side, is credit-driven and demand-led, not impacted by the fluctuations of specific elements of the balance sheet, such as the increase or decrease in foreign reserves. The interest rate is exogenous, a view which has been defended in recent years both by some mainstream and post-Keynesian economists, especially since most central banks pay less attention to the money aggregates. Romer (2000, p.150), though he did not admit the demand-determined money supply, criticized the weaknesses of the traditional IS/LM

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<sup>6</sup> Based on this relationship, if our theory holds, FR should be positively related to GD and Bond, and negatively related to Claim.

curve as well as its extension form IS/LM/AS, providing an alternative model, by replacing the LM curve with a horizontal interest rate rule. He concludes that "the new approach turns out to have many advantages beyond the obvious one of addressing the problem that the IS/LM model assumes money targeting."

This argument undoubtedly constructs a bridge connecting mainstream economists and Post Keynesians in the field of money. Furthermore, many French central bankers and scholars advocate the endogeneity of the money supply, as claimed by Le Bourva (1992, p.451) "... it is important to understand the quantity of money created for the private sector is the result of a twofold movement: one that affects new loans taken out, and one that concerns repayment of old loans. Should the new loans exceed the old, the quantity of money generated through credit will increase; whereas, should the new and the old be equal, the money supply will remain stable; and finally, if repayments were to exceed loans, the quantity of money will decline." It should be noticed that the endogenous money supply referred to in the Mundell-Fleming framework, as determined by changes in foreign assets in an open economy, is quite different from the endogeneity of money advocated here. "Money is still supply determined. These two views cannot be reconciled. Furthermore, the post-Keynesian view of money creation within an open economy precludes the notion that the supply of money be a function of the balance of payment surplus."(Lavoie, 1992, p.189)

Using a stock-flow model of two open economies, Godley and Lavoie (2006, p.241) provide simulations with administered rates of interest and confirm the

"compensation thesis", claiming that the amount of the money supply is independent of fluctuations in foreign reserves. Moreover, there is no "inconsistent trinity". If monetary authorities target interest rates, instead of the money supply, endogenous sterilization is necessary to offset the upward/downward pressure on interest rates induced by the external imbalance. Money is provided to satisfy the market demand, neither exogenously supplied nor endogenously induced by foreign exchange transactions. A corollary to this representation in the surplus case, such as that of China, is that there is no need to increase interest rates, avoiding risks of heavy fiscal costs if the central bank controls interest rates exogenously.

Recently, some economists have questioned the standard view about the long-run impossibility of sterilization. Frenkel (2007, p. 4) examined the case of Argentina, arguing that the monetary policy there is an "unorthodox" policy, where "the trilemma does not hold" and "the central bank can control the exchange rate and interest rate even with open capital markets", concluding that "the sterilization policy is sustainable, with considerable monetary autonomy, for long periods of time even indefinitely." Aizenman and Glick (2008, p. 2) evaluated the efficacy of sterilization by estimating coefficients to sterilize foreign reserves for some countries in Asia and Latin America, finding that "the greater accumulation of foreign reserves in recent years has been associated with a greater intensity of sterilization by developing countries in Asia as well as Latin America. In particular, we show that there has been a significant increase in the coefficient of sterilization following the 1997-98 Asian Crisis."

#### **1.4 The case of the Chinese economy**

Following its open door policy, international trade and foreign direct investment (FDI) in China have been promoted. Meanwhile, the reform of the Chinese exchange rate regime was implemented in 1994 by the Chinese central bank, putting a highly managed floating exchange rate in place. It was then set as a pegged exchange rate, following the instability due to the Asian Financial Crisis of 1997. The rate had been fixed at around 8.28 Yuan to the dollar for a long time.

From 1997 on, China gained huge twin surpluses. This rapid growth did not slow down after the Chinese central bank accepted a crawling peg appreciation of the Renminbi under the pressure of the US government in July 2005. By November 2006, China's foreign reserve had exceeded 1 trillion US dollars, which made China become the country with the largest foreign reserve in the world. By the end of 2007, the RMB has appreciated by 13.31% cumulatively against the US dollar after the reform in 2005, while the growth rate of foreign reserves remains high, at 43.32%. (PBC 2007<sup>7</sup>) Between December 1999 and November 2007, foreign assets have increased by 745%, and the bond issue has risen by 1741%, whereas total claims on government and financial institutions have expanded only by 54%. According to those statistics, China seems to be a good case to examine the effect of large foreign reserves on different variables of the balance sheet of the Chinese central bank. As said by Lavoie (2006, p.15), "China thus looks like an interesting case to test the validity of the

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<sup>7</sup> China Monetary Policy Report Quarter Four, People's Bank of China  
<http://www.pbc.gov.cn/english/detail.asp?col=6618&ID=44>

compensation thesis versus the standard fixed exchange rate Mundell-Fleming predictions."

The Chinese economy is also interesting because of the substantial amounts of central bank claims on financial institutions, and the relatively small amount of claims on the domestic government, which shows that China has obvious characteristics of an overdraft economy. Referring to Table 4, claims on banks and financial institutions represented about 95% of its total claims in 1999 and this number was 71% in 2007. In terms of total central bank assets, credits to banks and financial institutions stood at 54% in 1999 and 14% in 2007 respectively. These statistics show that advances from the Chinese central bank to the financial institutions plays an important role.

The large value of the central bank advances is mainly comprised of three parts. Firstly, as one would expect, to satisfy the demand for loans by firms and consumers, commercial banks borrow large amounts of advances from the central bank. A good example is the amount of currency representing a large proportion of reserve money, about 45% and 34% in 1999 and 2007. As more banknotes are being demanded by consumers, domestic banks have no choice but to borrow them from the central bank. Secondly, in the early 1990s, the Chinese treasury department was not able to afford funds needed to develop the reform of financial institutions, which were partly transferred to the Chinese central bank. Some new state-owned banks such as Agricultural Development Bank of China were established with loans from the central bank. Thirdly, the less regulated credit criteria of state-owned banks led to huge nonperforming loans which required central bank relending to insure their survival.

Thus, the Chinese economy seems to be a kind of impure overdraft economy, which is a little different from the traditional overdraft economy as defined by Lavoie (2006, p.18) "... in an overdraft economy, firms are always in need of advances from banks, and banks are always indebted to the central bank." In the Chinese style overdraft economy, apart from granting advances to domestic banks to satisfy the demand from firms, the central bank needs to act as a lender of last resort, in order to fill the capital deficiency due to the large amount of bad loans.

Table 1.4: The balance sheet of the People's Bank of China, in 100 million RMB

	December 1999	November 2007
<b>Assets</b>	<b>35349</b>	<b>165299</b>
Foreign assets	14458	122170
Total Claims	20337	31412
Claims on government	1582	8825
Claims on banks and other financial institutions	19207	22260
<b>Liabilities</b>	<b>35349</b>	<b>165299</b>
Reserve Money	33620	92433
Currency	15069	31389
Deposit of financial	14728	60775
Bond Issues	118	35667
Deposits of Government	1785	23159

*Source: People's Bank of China*

The Chinese central bank has three options to offset the effects of its large balance of payment surplus: (1) sterilized intervention; (2) unsterilized intervention;

(3) floating exchange rate. If China's foreign exchange policy is not adjusted, foreign reserves are expected to accumulate by about 200 billion dollars per year in the future. The Chinese central bank has actively implemented a combination of measures to wipe out the excess liquidity. However, the success and effectiveness of sterilization has remained controversial. Many Chinese economists, followers of mainstream economics, criticize sterilization on the following grounds.

(1) The sterilization operation may push up interest rates, leading to an international capital inflow and hence putting more upward pressure on the interest rate.

Meanwhile, the rise of interest rates deteriorates investment and causes a contraction of the economy, which makes the financial market worse. (Yu and Zhong 1997)

(2) The central bank almost sold out all government securities to sterilize huge foreign assets before 2002 and had to turn to the liability side, selling central bank bills, to continue the sterilization operation. This instrument of sterilization raises interest rates of bonds issued by the central bank, increasing the cost of open market operations. Once the interest rate is higher than the rate of US treasury bills, there would be an income loss resulting in a payment deficit of the monetary authorities.

(Yu, 2007)<sup>8</sup>

(3) As an option of processing sterilization, the reduction of claims to the financial institutions distorts the market demand for loans. Export oriented firms in developed regions obtain more money by exchanging foreign assets while firms located in

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<sup>8</sup> Source: 21st Century Economic Report,  
<http://finance.sina.com.cn/review/zlhd/20070710/09483769796.shtml>

impoverished areas which require advances more urgently, receive less, subsequently inducing inequality in the economic development of China. (Liu and Li, 2000)

In addition, Gu and Zhang (2006, p.49) have argued that monetary policy is powerless to impact interest rates in a fixed exchange regime and Chinese government “has been forced to buy up excess foreign exchange to maintain the RMB’s stability, thereby increasing the money supply. ... This sterilization action sooner or later might become less effective as speculation continues, and the resulting increase in Forex reserves might expose the country to greater currency risk.” Mundell (2007)<sup>9</sup> himself has asked the Chinese central bank to stop sterilization to bring its external imbalances back to balance, claiming that this action will also “increase absorption, imports, and total spending by people in China.” In an interview, he argued that China’s high external surplus and inflationary pressures on the Renminbi will be resolved easily by halting sterilization, in order to satisfy the market demand for money. “By sterilization, the central bank prevents the supply from rising fast enough to satisfy demand, perpetuating the imbalance. Raising the required reserved ratio has the same effect. Ease off sterilization and monetary tightening, Prof. Mundell predicts, and the demand for the Yuan will soon be saturated.” (Restall, 2007, p.16)

Nevertheless, all these negative effects of sterilization operations can be dismissed with the help of the compensation thesis. Firstly, interest rates are administered by the central bank. There is no incentive for the Chinese central bank to set an interest rate which is higher than the rate on US treasury bills. In fact, sterilization is necessary to

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<sup>9</sup> Source: BusinessWeek, May 7, 2007

keep monetary policy stable since the downward pressure on interest rates due to soaring foreign reserves is offset by the upward pressure caused by the intervention of the central bank. Moreover, advances are provided as they are demanded by domestic banks to satisfy the needs of firms, whether they are from developed or impoverished regions. It is unnecessary for the central bank to cut off advances and reduce the amount of debt towards the central bank when banks exchange foreign currencies with the central bank, unless the request for further loans is not in accord with criteria. Therefore, there is no uneven economic development arising from sterilization. In contrast, the central bank is the institution which collects foreign capital inflows from rich areas and redistributes capital to areas where it is needed, thus tending to reduce the inequality between regions.

Yi, the deputy governor of the People's Bank of China, claimed that "As long as the international payment imbalances exist, the Chinese central bank should insist on the sterilization intervention to ensure interest rates under control. ... To deal with the pressure of the liquidity caused by the exchange settlement system, the Chinese central bank will strengthen sterilization through the control of treasury bills and open market operations."<sup>10</sup> Aizenmam and Glick (2008, p.7) analyzed the extent of sterilization in China and found that "since mid-2002, however, as China experienced sharply rising foreign reserves inflows, these inflows were accompanied by negative changes in domestic asset holdings by the central bank, primarily through sales of PBC bills, implying the reserve inflows were being sterilized." Ouyang and Rajan

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<sup>10</sup> Source: China Finance, 2008, <http://www.gjmy.com/html/JJLW/JJXLW/2008/08/12176.html>

(2006, p.20) assessed the offsetting coefficients by undertaking an empirical investigation, examining the relationship between net domestic assets and net foreign assets. Their empirical results show that “the estimated coefficient increased markedly from moderate sterilization in 2002 to heavy sterilization in 2004”

Following the increase in the inflation rate since 2007, many Chinese economists worry that the rapid accumulation of foreign assets will provide much pressure on inflation, arguing that it is difficult for the Chinese central bank to maintain a low level of inflation with large twin surpluses. "To maintain the stability of the Chinese exchange rate, the Chinese central bank has to strongly intervene in the foreign exchange market, which means the central bank supplies high powered money. Assuming the exchange rate towards the US dollars is 8:1 and the twin surpluses are 200 billion US dollar, the central bank has to issue 1.6 trillion RMB to the domestic banking system, definitely leading to the rise of the CPI and capital price." (Yu, 2007)

<sup>11</sup> Moreover, some of them argue that loosening the managed exchange rate is the best option to stop the foreign reserve buildup. (Jiang, 1999, He, 2000) The US Congress also wishes for a 20% or more RMB appreciation, blaming China’s low speed of appreciation and US senator Schumer even advocated a 27.5% import tariff on Chinese products unless China significantly revalues the RMB.

These propositions undoubtedly support the Mundell-Fleming analysis of “money supply induced inflation”. However, the obvious evidence that China has had a twin surplus for over 10 years while the inflation rate started to rise only in 2007

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<sup>11</sup> Source: 21st Century Economic Report, July, 2007

seems to falsify Mundell and his proponents' theory. How can the Chinese central bank keep inflation stable if mainstream theory is valid? As a matter of fact, these ideas would be illogical, once we accept that the supply of high-powered money is determined by market demand, independently of the increase in foreign reserves. The accumulation of foreign reserves is sterilized by changes in other items of the balance sheet and the money supply is only increasing with its demand. As to the cause of the sudden upsurge in inflation, most likely, it arises from a world-wide cost-push inflation induced by rising raw materials prices and agricultural prices, and only partly from demand-led inflation. Soaring food prices are the main driving force behind the high inflation rate, whereas non-food prices remained fairly stable. Food prices have increased by 12.3% thus contributing 4% to CPI growth. However, inflation remained at a high level only for less than one year and started to decline with falling raw material prices since July 2008, whereas foreign reserves kept rising. This evidence clearly ruptures Mundell's causality that an increase in foreign reserves causes an increase in money supply and thus a higher price level. Empirical results that I put in the empirical part also significantly support our claim, showing that there is no relationship between foreign reserves and the price level in the case of China.

Mundell's "money supply-led inflation" was perhaps correct when countries were subject to a commodity-based monetary system which played a dominating role until the end of pre-1914 golden standard and the Bretton Woods system. In this situation, money comes into existence as a result of the production of gold or silver, and the value of money is determined by the prices of such commodities, the total

quantity of which is exogenously pre-determined. Exogenous money thus applies here and inflation arises from more supply of commodity-based money because it causes a devaluation of commodity-based money and hence the rise in related prices of consumption goods. However, this rationale would become absurd in the current modern economy in which paper money does not have any intrinsic value. In this “credit-based” money system, the appearance of money is caused by the demand for bank credits by households and firms in order to finance their expenditures of consumption and investment or the enlargement of stocks. The supply of credit money is demand induced, instead of exogenously issued, and thereby breaks Mundell’s causality of inflation<sup>12</sup>. As concluded by Kaldor (1989, p.187) “..... the behavior and the significance of changes in the money supply will be quite different depending on whether we consider a commodity-money economy or a credit-money economy. .... Any change in the money supply is consequential on the change in demand and not the other way around”

## **1.5 Empirical tests**

### **Introducing the empirical analysis**

We now turn to the empirical part of this paper, where we examine whether endogenous sterilization is compatible with the Chinese economy. We check whether there is a long-run relationship between foreign assets and reserve money and between foreign assets and total credits, central bank bills, etc. According to the

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<sup>12</sup> Post-Keynesians argue that inflation mainly arises from both increases in both wage level and world raw material prices, which has little to do with monetary policies.

Mundell-Fleming model, there should be a relationship between foreign assets and reserve money under a fixed exchange rate regime, with the change in reserve money being caused by the change in foreign assets. According to the compensation thesis, there should be a long-run relationship between foreign assets and central bank bills and domestic loans.

We use a cointegration test with bootstrapping to study these relationships. First of all, we test for the presence of a unit root for each variable. Secondly, we figure out the cointegration rank, i.e., how many stationary cointegration relationships there are in our system. Thirdly, we identify cointegrating vectors in each relationship, putting some restrictions on cointegrating vectors by testing hypotheses on the long-run coefficients  $\beta$ . Our purpose is to provide evidence that if endogenous sterilization holds, there is at least one cointegration relationship in our system, with reserve money being excluded from the relationship, while foreign assets have a negative effect on total advances on domestic financial institutions and a positive one on central bank bonds. The presence of reserve money in the cointegrating system would provide support for traditional theory, that of the Mundell-Fleming model.

## **Data**

All tests are applied to five monthly data series obtained from balance sheets of the People's Bank of China. These five series are foreign assets, reserve money, total claims, bond issues, and government deposits, going from December 1999 to November 2007. It is necessary to explain that the reserve money indicator, which is

also called base money, includes currency and reserve deposits of financial and non-financial institutions. Total claims are comprised of four elements, claims on government, claims on deposit money banks, claims on specific depository institutions, and claims on other financial institutions. On the liability side, apart from reserve money, central bank bonds and government deposits are taken into consideration as well, while foreign liabilities and own capital are excluded from our tests because of their small amounts in the balance sheet. For the sake of simplicity, all five variables: foreign reserves, base money, total claims, bond issues and government deposits are expressed as FR, MB, Claim, Bond and GD respectively and they are transformed into logarithmic form.

As is noticed, the sample size of each variable is not large: it has only 96 observations since Chinese official statistics were not clear and reliable<sup>13</sup> until the end of the 1990s and thus data from the official website of the Chinese central bank are all starting from 1999. Furthermore, the data series of the bond issue is incomplete, with missing values from March 2000 to August 2002. To make the model operate properly, I interpolate those missing values in a time series with the help of SAS, computing the average point over each month. The following two graphs show the series of bond issue without and with embedded interpolation values.

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<sup>13</sup> In fact, statistics of the Chinese central bank started to appear on the website since 1999. Data are volatile because of some serious problems in data collection and organization before 1999.

Figure 1.1: The log of monthly Chinese central bank bonds with missing values.

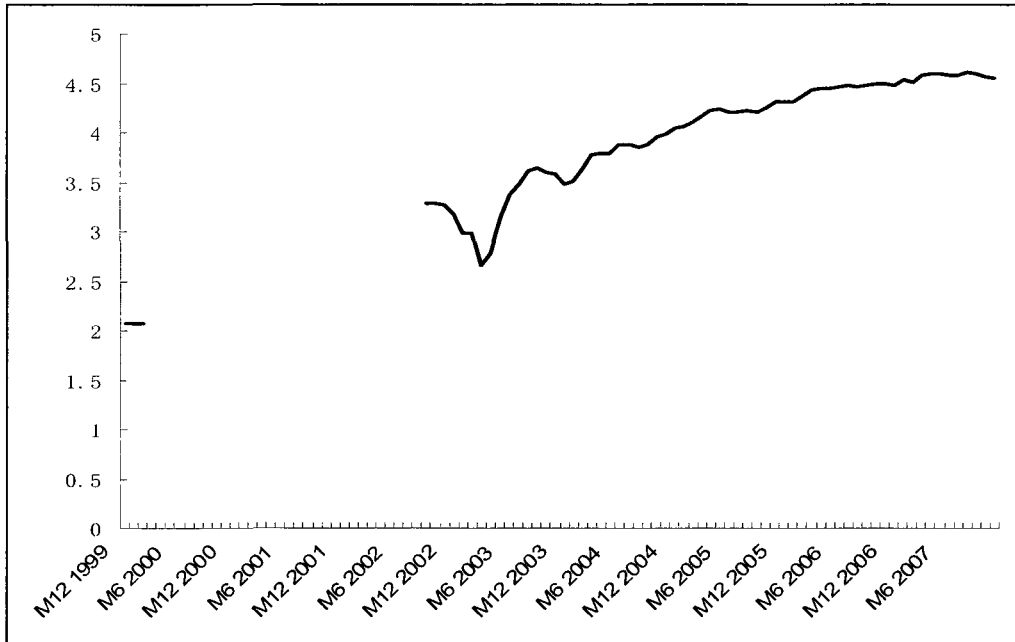
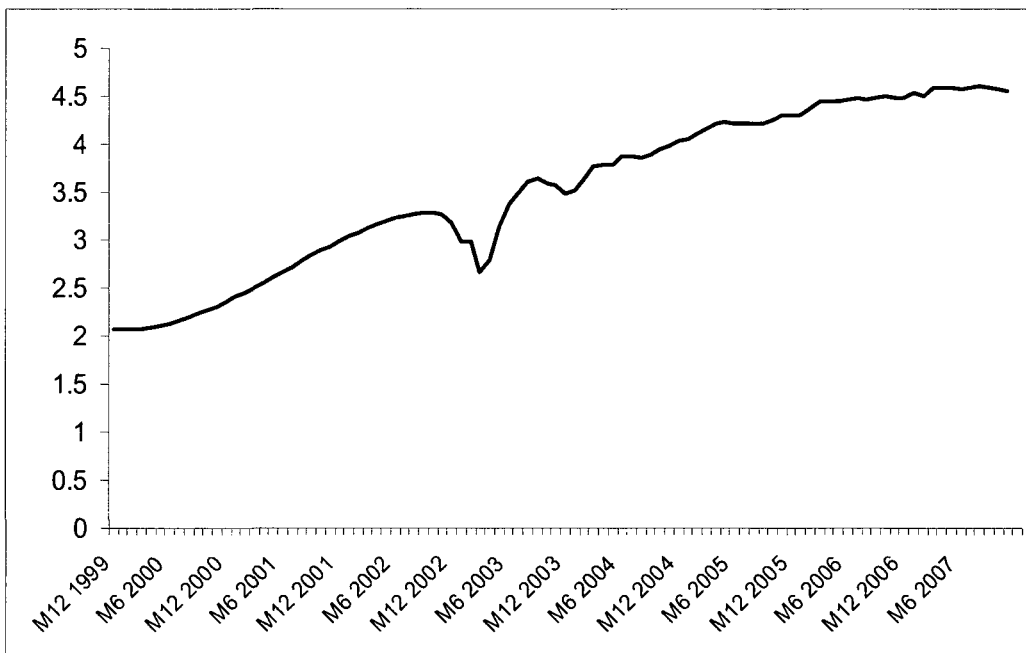


Figure 1.2: The log of monthly Chinese central bank bonds with interpolation values



In addition, China left the fixed exchange rate with the US in July 2005, thus the data after that date suffer from some contamination if foreign reserves in the balance sheet are in RMB,<sup>14</sup> and so the data of foreign assets are collected from those in units of US dollars<sup>15</sup>. Although China started to increase the proportion of other currencies such as Euros and Yens in foreign exchange reserves, according to unofficial sources, about 80% of Chinese foreign reserves are still invested in US dollars,<sup>16</sup> thus we skip the possible contamination due to fluctuations in exchange rates of other currencies. All five data series used in the test are shown in Figure 1.3.

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<sup>14</sup>  $\Delta FR = \Delta US * EX + US * \Delta EX$ , where FR, US and EX represent foreign reserves in RMB, foreign reserves in US dollars and the value of RMB in dollars (the exchange rate) respectively. Changes in foreign reserves in RMB ( $\Delta FR$ ) reflect partially a capital loss, when the dollar depreciates. Ideally, the foreign reserves data should be adapted to remove the capital loss, because what counts is the value of the flow change in reserves, not the change in the value of the stock of reserves. To avoid this kind of contamination, we use the first part of the right hand side of the equation ( $\Delta US * EX$ ) in our tests.

<sup>15</sup> In our tests,  $FR (\text{¥}) = \Delta US * EX$ , where the data of  $\Delta US$  are obtained from the Chinese central bank.

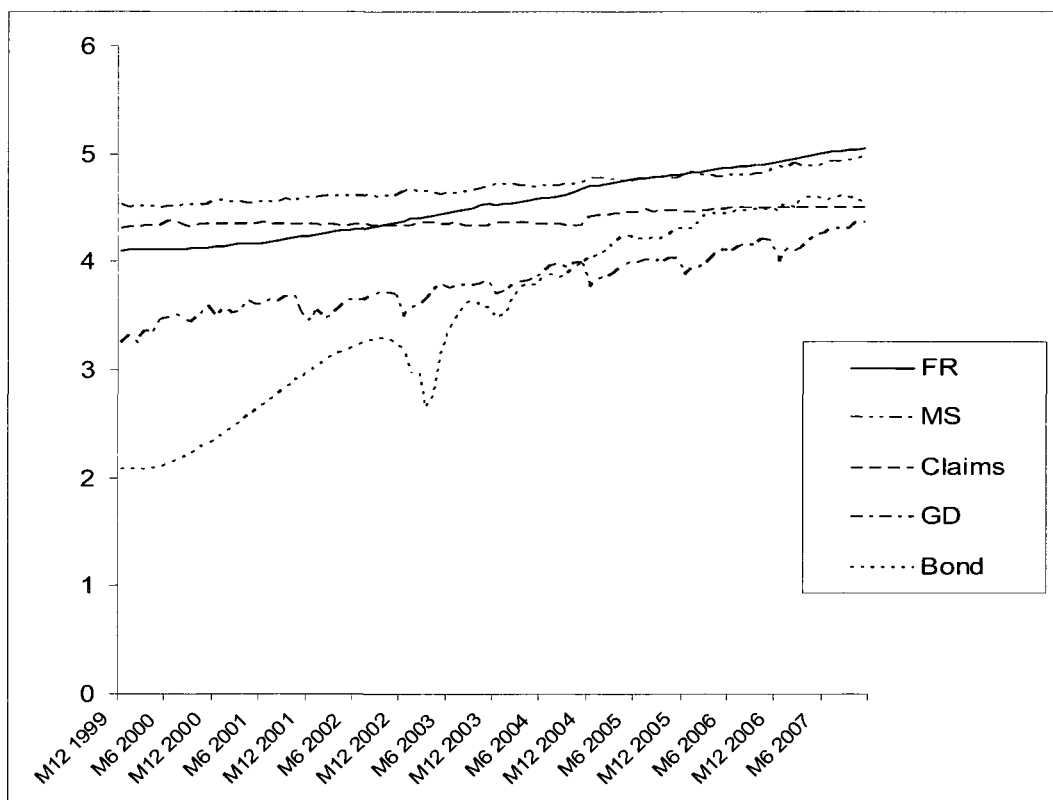
<sup>16</sup> Source: Euro riding high as an international reserve currency, Deutsche Bank Research, May 4, 2007,

[http://www.dbresearch.com/PROD/DBR\\_INTERNET\\_EN-PROD/PROD000000000209994.pdf](http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD000000000209994.pdf)

Moreover, Frank Gong, chief China economist for JPMorgan claimed in a newly released report that China aims to keep the bulk of its reserves in dollars -- even if they are not invested in the debt of U.S. mortgage agencies Fannie Mae and Freddie Mac -- because it favors a strong U.S. currency. He also said it was unlikely that China would diversify into the euro, yen or commodity currencies in a big way as these currencies may already have peaked. (International Herald Tribune, August 19, 2008)

<http://www.iht.com/articles/2008/08/19/business/19yen.php>

Figure 1.3: Five monthly data series of the Chinese central bank in logarithms



### Unit Root Tests

Different unit root tests are used and the lag length is selected by the Modified AIC. In Table 5, Panel A presents the result of the most popular Augmented Dicky and Fuller unit root test. Panel B extends the GLS detrending procedure of Elliott, Rothenberg and Stock (1996) to the ADF test and Panel C calculates two unit root statistics using GLS detrended data for each variable introduced by Ng and Perron (2001). The reason why I added the latter two tests to support the result of the ADF test is that many studies have shown they improve the finite sample performance with better size and power properties. Table 1.5 suggests that there is a unit root in each variable, meaning that all five data series are nonstationary. Therefore, we can proceed to the

subsequent steps of econometric methodology to test the cointegration relationships.

Table 1.5: Unit root tests

Panel A: ADF Test <sup>17</sup>				
Variables	Lag Length	Test Statistics	Critical Value (95%)	P-value
Foreign Reserves	1	-2.566981	-3.462292	0.2963
Reserve Money	1	-0.294775	-3.462912	0.9896
Total Claims	0	-1.800810	-3.457808	0.6968
Government Deposits	11	-0.582406	-3.464198	0.9774
Bond issues	1	-1.479628	-3.460516	0.8295
Panel B: Dicky-Fuller GLS Test <sup>18</sup>				
Variables	Lag Length	Test Statistics	Critical Value (95%)	
Foreign Reserves	1	-1.113653	-3.049200	
Reserve Money	10	-0.326013	-3.078000	
Total Claims	0	-1.784086	-3.046000	
Government Deposits	11	-1.506591	-3.081200	
Bond issues	1	-1.702304	-3.062000	
Panel C: Ng-Perron Test <sup>19</sup>				

<sup>17</sup> The null hypothesis is that the variable has a unit root.

<sup>18</sup> The null hypothesis is that the variable has a unit root.

<sup>19</sup> The null hypothesis is that the variable has a unit root and critical values for the corresponding  $MZ_{\alpha}$  and  $MZ_{\tau}$  statistics obtained from Ng-Perron are -17.3 and -2.91 respectively.

Variables	Lag Length	MZ <sub>α</sub> Test Statistics	MZ <sub>t</sub> Test Statistics
Foreign Reserves	1	-2.23484	-1.03668
Reserve Money	0	-12.9540	-2.30717
Total Claims	0	-6.01340	-1.73168
Government Deposits	11	-0.52141	-17.3000
Bond issues	0	-6.52629	-17.3000

### Econometric methodology

In this paper, we select the likelihood ratio (LR) test of cointegration rank (Johansen, 1988) to test for cointegration, as this test has been much used in recent studies because of its relative simplicity to calculate LR statistics by reduced rank regression. The 5-dimensional vector autoregressive (VAR) model is considered to analyze the multivariate nonstationary data.

$$\Delta X_t = \alpha\beta'X_{t-1} + \Gamma_1\Delta X_{t-1} + \dots + \Gamma_{k-1}\Delta X_{t-(k-1)} + \alpha\rho't + \mu_0 + \varepsilon_t \quad t=1, \dots, T \quad (1)$$

where the error term  $\varepsilon_t \sim N(0, \Omega)$  and  $\Gamma(L) = 1 + \Gamma_1L + \Gamma_2L^2 + \dots + \Gamma_{k-1}L^{k-1}$ ,  $k$  is the lag length. In our case,  $X_t = [FR_t, Ms_t, Claim_t, Bond_t, GD_t]$  has five dimensions and the reduced rank  $\Pi = \alpha\beta'$  is  $5 \times 5$  matrix, where  $\alpha$  and  $\beta$  are both  $5 \times r$  matrices of rank  $r$ . The model assumes  $\mu_0 + \alpha\rho't$  as the deterministic term, including the constant and the linear trend. Under the null hypothesis of rank  $H(r)$  and the alternative hypothesis of rank  $H(p)$ , Johansen(1995) calculated the LR test and the so called trace statistic is of the form

$$Q(r) = -2\log\left(\frac{L(H(r))}{L(H(p))}\right) = -(T - K) \sum_{i=r+1}^n \log(1 - \hat{\lambda}_i) \quad (2)$$

where the eigenvalues  $1 > \lambda_1 > \dots > \lambda_p = 0$  are the ordered roots by solving

$$\left| \lambda S_{11} - S_{10} S_{11}^{-1} S_{01} \right| = 0 \quad \text{and} \quad S_{ij} = (T - k)^{-1} \sum_{t=k+1}^T R_{it} R'_{jt}, \quad i, j = 0, 1$$

where  $R_{it}$  and  $R_{jt}$  are residuals by regressing  $\Delta X$  and  $(X_{t-1}, t)'$  on  $\Delta X_{t-1}, \dots, \Delta X_{t-k+1}$  and a constant.

However, as shown in the previous part, our test is based on a small sample size, less than 100 observations for each variable in our data set. This does not seem to be large enough for the conventional cointegration test. "It is important to study the behavior for small to moderate samples of sizes empirical research usually encounters, say 50 to 200 observations." (Gredenhof and Jacobson, 2001, p.63) Many economists believe that the small sample size cannot provide reliable empirical results since maximum likelihood cointegration procedure relies on asymptotic considerations. A number of simulation tests show that there is much difference in the cointegration trace test between the small sample and asymptotic properties. "It is now widely recognized that inference based on asymptotic distributions has two major drawbacks: (a) The estimators, though consistent (and often super consistent) have substantial small sample biases and (b) The tests of significance based on the asymptotic distributions have substantial size distortions." (Li and Maddala, 1997, p.299)

Johansen (2002, p.1929) pointed out that "the limit distribution of the test is often a poor approximation to the finite sample distribution and it is therefore relevant to derive an approximation to the expectation of the likelihood ratio test for cointegration in the vector autoregressive model in order to improve the finite sample properties." Basically, the problem can be regarded as a lack of coherence between the test statistics and its corresponding distribution, and there are two methods usually considered to alleviate the distortion, either correcting the reference distribution given test statistics or modifying test statistics given the reference distribution. The latter correction can be implemented by the Bartlett factor, which is proposed by Johansen (2002), suggesting that by computing the expectation of the LR statistics over the small sample distribution, we can correct this statistics, keeping the same sample mean.

Alternatively, the bootstrap approach could be considered as a feasible way to estimate the small sample distribution of the statistics. Swensen (2006) suggested bootstrap algorithms for a reduced rank VAR model to approximate an asymptotic distribution by a bootstrap distribution. He calculates OLS estimators  $\Gamma_1, \Gamma_2, \dots, \Gamma_{k-1}, \mu_0, \alpha, \beta$  and residuals  $\varepsilon_{k+1}, \varepsilon_{k+2}, \dots, \varepsilon_T$  under the null hypothesis of the reduced rank is  $r$ , and constructs the new samples of bootstrapped or pseudo-observations  $X_1^*, X_2^*, \dots, X_T^*$  based on the equation (1) by drawing the residuals  $\{\varepsilon_i^*\}$  from the estimated residuals with replacement. If we let the recursive bootstrapping process replicate  $B$  times, there will exist  $B$  bootstrap samples  $X_{1j}^*, X_{2j}^*, \dots, X_{Tj}^*, j=1, \dots, B$ , and trace statistics  $Q_j^*$  of interest that can be computed  $B$  times in each bootstrapped

samples. These are ordered into a bootstrapping empirical distribution and the bootstrapped p-value is computed in the form of:

$$p^* = \frac{1}{B} \sum_{j=1}^B I(Q_j^* > \hat{Q}),$$

where  $I(\dots)$  is an indicator function and  $\sum_{j=1}^B I(Q_j^* > \hat{Q})$  denotes the number of elements in the set I.

There are two basic approaches, parametric and non-parametric bootstrapping, usually used by economists to bootstrap data. The parametric bootstrapping draws the new innovations from a multivariate standard normal distribution and then calculates the covariance matrix from the original estimated residuals to transform those new innovations into bootstrapped residuals. The non-parametric bootstrapping, such as the block bootstrap, which is more common and closely related to the one proposed by Swensen (2006). It resamples the original estimated residuals by drawing independently with replacement to obtain bootstrapped samples and thus each sample of observation is drawn with the same probability. Both of these approaches have been claimed to be effective to improve the performance of the asymptotic distribution of test statistics by many studies. Davidson (2002) used the parametric bootstrapping to test the existence of the cointegration relationship and applied it to the example of UK consumption and disposable income, concluding that the test is consistent with both stationary and nonstationary cointegrating residuals and performs

better. Applying bootstrap procedures to the case of US consumption, income and wealth, Davidson (2006) showed that these tests function reasonably well in a small sample even if they are not asymptotically pivotal.

### **Empirical evidence**

We now turn to the empirical evidence of this paper. Cointegration of rank  $r$  is carried out using the regular Johansen cointegration test first. According to Figure 1.3, there is a significant intercept and trend for each variable, thus, only the case of a constant and restricted linear trend is examined<sup>20</sup>. Centered seasonal dummies are also taken into account because of the significant seasonal adjustment shown in the dataset. The number of the lag length<sup>21</sup> is 1 which is optimally selected by AIC, FPE, HQC and SC. Table 1.6 presents inference about the conventional cointegration test.

The conventional cointegration test suggests  $r = 1$  (Table 1.6). However, as argued in the previous part, the inference might be distorted by poor approximations in small-sample distribution. I use two measures to investigate the robustness of the cointegration inference, Bartlett correction and bootstrap.

Table 1.7 indicates improved empirical results with asymptotical critical values. Using a standard 5% significant size, we can find that the cointegration rank is 1. The implementation of the correction factor leads to some changes in the trace statistics, but new results still favor our conclusion that  $r = 1$  though the trace statistics

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<sup>20</sup> All tests are done by the Matlab based software SVAR developed by a time series econometrician Warne, who is working at the European Central Bank. <http://texlips.hypermart.net/warne/index.html>

<sup>21</sup> Lag length = number of lagged difference terms

corrected by Bartlett factors become much smaller.

Table 1.6: Conventional Cointegration Analysis

$H_0$	LR trace statistics	P-value
$r=0$	103.8756	0.0027
$r \leq 1$	58.2383	0.1361
$r \leq 2$	27.3508	0.6607
$r \leq 3$	10.9310	0.8791
$r \leq 4$	3.7486	0.7781

Table 1.7: Bartlett Corrected Cointegration Analysis

$H_0$	LR trace statistics (Corrected)	90%	95%	99%	Bartlett Factor
$r=0$	95.5538	84.380	88.800	97.600	1.087089
$r \leq 1$	49.8888	60.090	63.880	71.470	1.167362
$r \leq 2$	18.1405	39.750	42.910	49.360	1.507718
$r \leq 3$	8.7188	23.340	25.870	31.160	1.253734
$r \leq 4$	2.7034	10.670	12.520	16.550	1.386616

Table 1.8: Simulated Critical Values with Corresponding Quantiles

	Panel A			Panel B			Panel C		
	$H_0: r=0$ against $H_a: r \geq 1$			$H_0: r=1$ against $H_a: r \geq 2$			$H_0: r=2$ against $H_a: r \geq 3$		
Quantiles	0.9	0.95	0.99	0.9	0.95	0.99	0.9	0.95	0.99
Critical values	84.38	88.8	97.6	60.09	63.88	71.47	39.75	42.91	49.36
DGP rank									
0	<b>82.82</b>	<b>87.29</b>	<b>98.78</b>	121.27	127.52	140.58	143.44	149.81	166.42
1	48.41	51.34	59.41	<b>57.38</b>	<b>60.04</b>	<b>68.17</b>	76.32	80.85	87.4
2	26.33	28.77	33.53	30.2	32.52	37.45	<b>34.75</b>	<b>37.74</b>	<b>44.29</b>
3	12.28	13.45	16.12	14.15	15.38	18.65	15.43	16.96	20.49
4	4.05	4.6	5.53	4.58	5.24	6.66	5.11	5.76	7.05
	Panel D			Panel E					
	$H_0: r=3$ against $H_a: r \geq 4$			$H_0: r=4$ against $H_a: r \geq 5$					
Quantiles	0.9	0.95	0.99	0.9	0.95	0.99			
Critical values	23.34	25.87	31.16	10.67	12.52	16.55			
DGP rank									
0	157.38	164.78	175.37	158.36	166.82	181.41			
1	88.2	93.21	102.07	89.93	94.56	104.97			
2	42.93	46.53	51.91	45.28	48.34	55.44			
3	<b>20.25</b>	<b>22.06</b>	<b>25.69</b>	22.46	23.96	27.14			
4	6.53	7.4	8.95	<b>7.91</b>	<b>8.94</b>	<b>10.9</b>			

Furthermore, we have undertaken the bootstrap study to simulate the corrected reference distribution<sup>22</sup>. Table 1.8 shows the new critical values of the simulated reference distribution for different quantiles. In Panel A-E of Table 1.8, the 90%, 95% and 99% percentiles are compared with the corresponding asymptotic critical values. Bold numbers represent critical values of the simulated empirical distribution when the null hypothesis is true. Note that almost all critical values from the empirical distributions are smaller than the asymptotic ones, i.e. the empirical distributions are

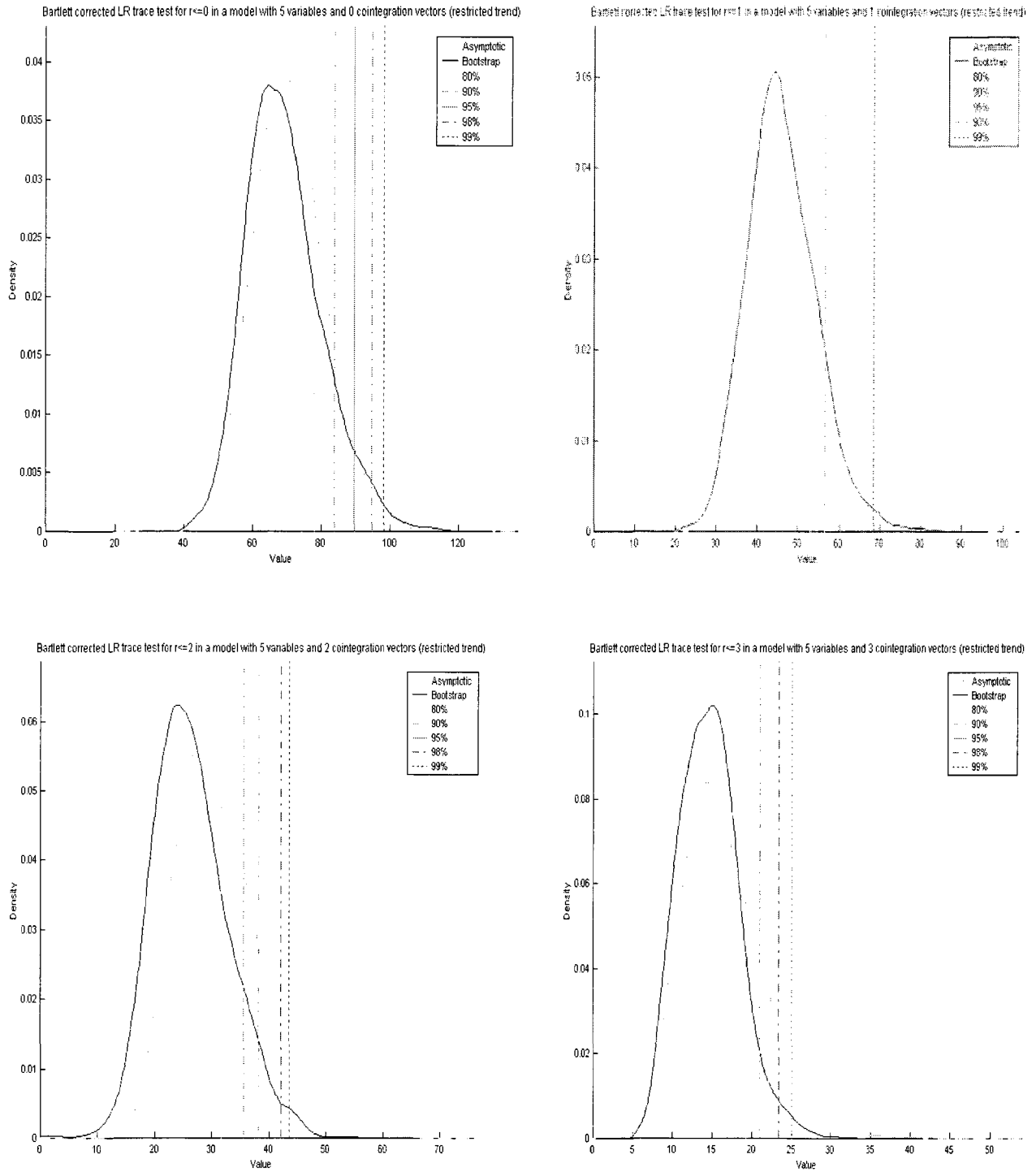
<sup>22</sup> Notice that when I bootstrap the new trace statistics Q, I put the Bartlett correction factor into the equation which makes less distortion.

skewed to the left of the asymptotic ones, which means that when we use the asymptotic critical values, there is a higher probability of underrejecting nulls.

This comparison can be illustrated by the density functions of the asymptotic and the empirical distributions in Figure 1.4. Note that in most panels, the critical values of the 95% percentiles of the empirical distributions are almost smaller than those from 90% percentiles of the asymptotic distributions. In other words, if we use the 10% critical values of the asymptotic distributions, the trace statistics show rejection frequencies of roughly 5% or less for the five nulls, i.e. the statistics are undersized so that we are more inclined to reject true nulls at some lower level than the desired level, say, 10%.

This comparison can be illustrated by density functions of the asymptotic and the empirical distributions in Figure 1.4. The four graphs are different density functions under the assumption that the true rank is 0,1,2,3. The blue dotted curve is an asymptotic curve and the black curve is the empirical curve. We see that the empirical distributions are skewed to the left of the asymptotic ones. Take the 3<sup>rd</sup> graph as an example: the 80% percentile line for the empirical distribution covers more area than for the asymptotic distribution. In other words, rejection rates are much lower for the empirical distribution.

Figure 1.4: Density functions of the asymptotic and empirical distributions of the trace test for cointegration rank



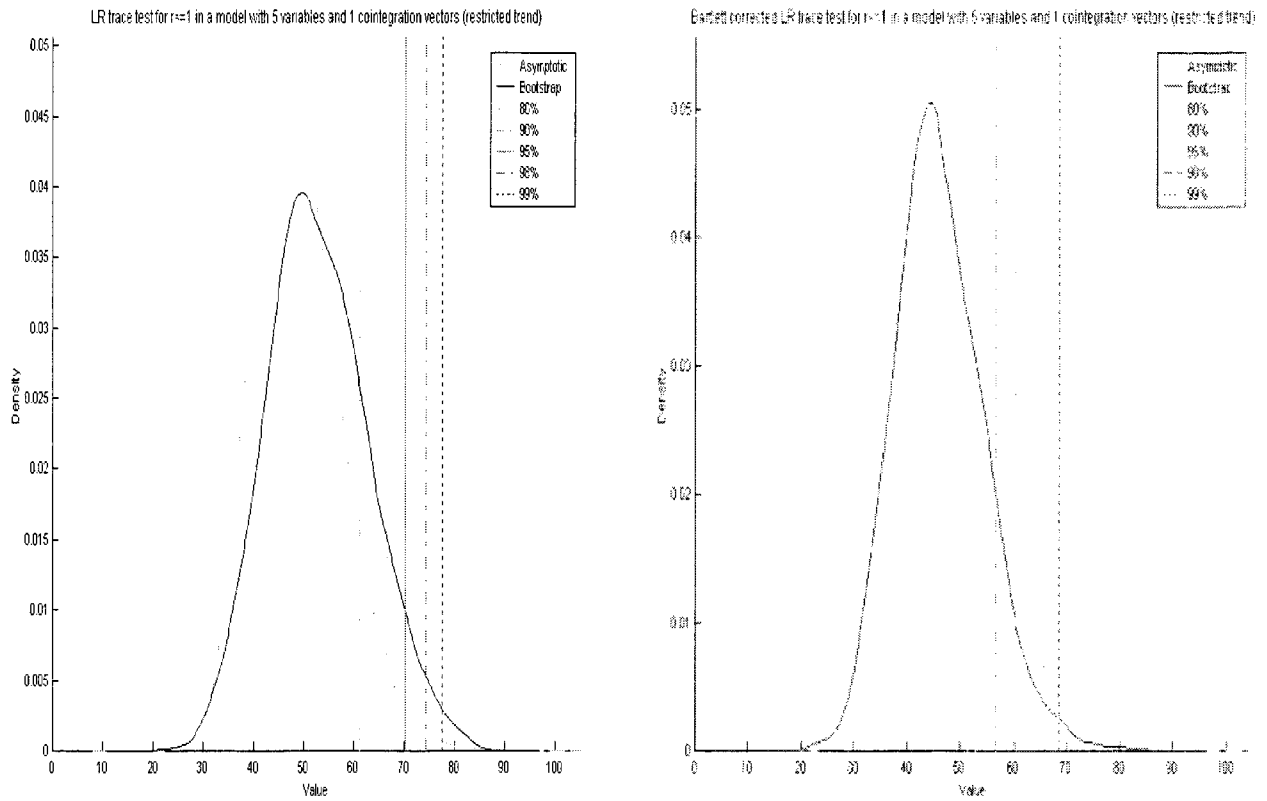
This explanation can also be shown in Table 1.9. Under the 5% rejection level, rejection rates for different nulls are all smaller than 5%. Again, it means that the distortion of the asymptotic distribution make it more difficult to reject nulls.

Figure 1.5 illustrates the improvement of the distribution corrected by the Bartlett Correction, which is used in the right graph. We see that the areas covered by the right tails of the two curves are closer after correction. The reason for which there is not much difference between the nominal 5% and the empirical values shown in the Table 1.9, especially for  $r=0$  and 1, is that I use the Bartlett Correction Factor in my bootstrap test. In this figure, the two asymptotic curves remain at their position but the empirical curve skews to the left once it is corrected, matching the table where we have shown that the corrected LR statistics are smaller than the original ones.

Table 1.9: Rejection rates for different  $H_0$  in a 5% trace test (%)

	Number of Cointegration Vectors in the DGP				
Hypothesis	r=0	r=1	r=2	r=3	r=4
r=0	4.1	0.2	0	0	0
r=1	80.58	2.7	0	0	0
r=2	98.4	43.34	1.5	0.1	0
r=3	100	76.58	10.01	0.8	0.1
r=4	100	83.48	14.91	1.4	0.1

Figure 1.5: The comparison between distributions, with versus without Bartlett correction ( $r = 1$ )



To identify the cointegration relationship among the different variables, I test the long-run linear restrictions on  $\beta$ . By several trials of different null hypotheses, there is one null hypothesis, shown in the following, that cannot be rejected, with  $LR(2)=8.8017$  and the corresponding p-value at 0.1461, which means the variable MB is long-run excluded. This kind of exclusion test sets a null hypothesis where the number of restrictions is 2 and

$$\beta = \begin{bmatrix} FR \\ Claim \\ Bond \\ t \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} FR \\ MB \\ Claim \\ GD \\ Bond \\ t \end{bmatrix}$$

Therefore, the equilibrium relation (standard error in parenthesis) is given by

$$FR_t + 1.6891Claim_t = 0.0849Bond_t + 0.0136t \quad (3)$$

(0.393)                      (0.0801)                      (0.0027)

where the cointegrating coefficient of  $FR_t$  is normalized as 1. According to this equation, the signs seem ok. The asset side of the balance sheet of the Chinese central bank on the left hand side equals the liability side on the right hand side.

To make it straightforward to interpret the cointegrating relationship in terms of an error correction mechanism measuring the sterilization effect, I use two other expressions to show the marginal effect, the first of which normalizes on  $Claim_t$ , and the second of which normalizes on  $Bond_t$ :

$$Claim_t \sim -0.6FR_t$$

$$Bond_t \sim 11.7FR_t$$

If  $FR$  increases by 1%, the total claims will tend to decrease by 0.5%, or the bond issues will increase by 11.7%. Thus, effects of increasing  $FR$  on Claims and Bonds are opposite and  $FR$  seems to influence Bond much more than Claim.

## **1.6 Interpretation of empirical results**

In the case of the Chinese central bank with a fixed or highly managed exchange regime, the increasing foreign reserves impact the amount of total claims and central bank bonds. The independence of the money supply relative to reserves falsifies the Mundell-Fleming argument that the money supply is endogenously driven by the foreign exchange. In addition, the tested relationship suggests that there is an opposite movement between foreign reserves and total domestic credits whereas there is a comovement between foreign reserves and central bank bills. The relatively large cointegrating coefficient of Bond shows the significant role of bond issues in the present sterilization process by the Chinese central bank. These results seem to favor the theory of endogenous sterilization by the Chinese central bank.

## **1.7 Some robustness tests**

Many studies have shown that applying cointegration tests to bivariate systems is a good check of the overall plausibility and consistency of the results. Cointegration tests may have relatively lower power when applying higher dimensional system. (Lutkepohl and Kratzig, 2004) Thus, I put MB and FR into an error correction model. Table 1.10 shows that there is no cointegration between the two variables, supporting our previous result of the multivariate system that the amount of base money is not determined by changes in foreign reserves.

Table 1.10: Cointegration analysis of the bivariate system

Rank	LR	LR (Corrected)	Different Percentiles for Empirical Distributions		
			90%	95%	99%
$r = 0$	21.6352	20.3685	22.6073	25.8424	30.1025
$r \leq 1$	2.8098	2.0248	8.7029	10.0475	13.1077

Another test to verify the robustness of my empirical results is to redo all tests using samples from September 2002, getting rid of the missing values of the bond series. However, the sample size would be smaller and the bootstrap and Bartlett factors seem to be more important in this case. As indicated in Table 1.11, the LR statistics are also corrected by the Bartlett factor, distributions are improved by bootstrap, and the result of  $r = 1$  does not change.

Table 1.11: Cointegration analysis for data from September 2002

$H_0$	LR trace statistics (Corrected)	Different Percentiles for Empirical Distributions		
		90%	95%	99%
$r=0$	87.7615	81.4259	85.3673	89.7480
$r=1$	53.4697	58.2169	60.3460	63.4655
$r=2$	22.6086	36.9011	37.8526	44.7783
$r=3$	10.5445	20.3710	21.8638	24.9299
$r=4$	2.7003	8.3472	8.9914	10.8253

Moreover, the exclusion test shows only MB is excluded from the system by testing various hypothesis<sup>23</sup>. The identified cointegration vector is

$$0.3146FR_t - Claim_t = 1.1345GD_t + 0.083Bond_t + 0.00138t$$

$$(0.2384) \quad (0.1496) \quad (0.0238) \quad (0.0033)$$

To make it straightforward, this relation can be expressed by

$$Claim_t \sim 0.3FR_t \quad \text{if normalizing on } Claim_t$$

$$GD_t \sim 0.2FR_t \quad \text{if normalizing on } GD_t$$

$$Bond_t \sim 3.7FR_t \quad \text{if normalizing on } Bond_t$$

As foreign reserves increased by 1%, total claims, government deposits and central bank bills tend to rise by 0.3%, 0.2% and 3.7% respectively. There are a few differences in this case compared with previous results. The comovement of foreign reserves and claims seems to be more consistent with the data<sup>24</sup>. The slow speed of the increase in total claims might be due to the large increase in domestic credits in recent years, so that there is only a partial offset by sterilization<sup>25</sup>. Government

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<sup>23</sup> The number of restriction is 1 and LR(1)=0.6192 and p-value=0.4314

<sup>24</sup> Refer to the Figure 1.3

<sup>25</sup> The sign of  $Claim_t$  is reversed in this case, which seems inconsistent with the “compensation thesis”. There might be two reasons for this to happen. One is that the Chinese domestic market has been growing rapidly these years, with a large appetite for credits provided by the central bank. The Chinese central bank finds it more difficult to rely solely on reducing total claims to implement sterilization, although most Chinese economists argued that the reduction of advances to commercial banks had played a dominant role in sterilization before 2001. The other reason is that the proportion of claims to total assets has been diminishing a lot after 2003 due to the previous sterilization process. Meanwhile, foreign reserves are increasing at a faster speed. This leads to less space for the Chinese central bank to continue sterilization through a single instrument. As a matter of fact, since 2003, the Chinese central bank has been more inclined to issue bonds than to use other instruments. This might explain why the coefficient of  $Claim_t$  is consistent with the “compensation thesis” when incorporating all observations

deposits are cointegrated in this case, which seems to be meaningful since according to the data, government deposits have increased significantly. Some Chinese economists have pointed out that government deposits seem to have gained some significance in the sterilization process. (Li and Peng, 2007<sup>26</sup>, Chinese Financial Development Report, 2006) Furthermore, the effect of foreign reserves on bonds is much smaller in this case, although the bond issue is still the most important instrument of sterilization.

As said before, Mundell's causality of inflation, which he inherited from Irving Fisher's quantity theory of money, claiming that an increase in foreign reserves will lead to an increase in money supply and thereby a rise in prices, is still widely accepted by most Chinese economists. The following test is to investigate the relationship between the amount of foreign reserves and the CPI to check whether Mundell's statement is valid or not in the case of the Chinese economy. Empirical evidence shows there is no relationship between the two variables and Mundell's causality of inflation is thus invalid. It is unnecessary to worry about the negative effect of increasing foreign reserves on price levels not only due to endogenous sterilization but also due to the independence of inflation from the monetary system.

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starting from 1999, but has the wrong sign when dealing with the subsample starting from September 2002.

<sup>26</sup> China Financial and Economic News, April, 2008,  
[http://www.crifs.org.cn/0416show.asp?art\\_id=1923](http://www.crifs.org.cn/0416show.asp?art_id=1923)

Table 1.12: Cointegration analysis of Mundell's causality of inflation<sup>27</sup>

Rank	LR	LR (Corrected)	Different Percentiles for Empirical Distributions		
			90%	95%	99%
$r = 0$	25.036	21.7575	23.34	25.87	31.16
$r \leq 1$	3.5097	3.4125	10.67	12.52	16.55

### 1. 8 Concluding remarks

This present paper tries to uncover the mechanisms that underlie the operations carried out by the central bank to deal with changes in foreign reserves, by comparing the mainstream Mundell-Fleming model with the post-Keynesian endogenous sterilization hypothesis which is also called the “compensation thesis”. In the Mundell-Fleming model, interest rates are endogenous variables and monetary policy is exogenously assessed by the money supply level in the case of a floating exchange regime, while the money supply is endogenously driven by changes in foreign reserves, with sterilization being ineffective in the case of a fixed exchange rate.

By contrast, the endogenous sterilization approach claims that the central bank is expected to actively sterilize increasing foreign reserves by reducing domestic credits or increasing its issues of central bank bills and government deposits. In this way, the money supply is independent of foreign reserves and the pressure on interest rates due to the increasing foreign reserves is automatically offset by the movement in the other elements of the balance sheet so that the central bank keeps interest rates under

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<sup>27</sup> The number of lags is 2.

control. The endogenous sterilization is supported by examining the case of the Chinese central bank with cointegration analysis. Several robustness tests are given as well, showing that there is no long-run relationship between foreign reserves and the base money, whereas foreign reserves have a long-run relationship with the amount of total claims and the amount of central bank bonds, with the latter playing the dominant role in endogenous sterilization.

## Chapter 2: Regional Economic Growth in China: Evidence from a Kaldorian Perspective

### 2.1 Introduction

Nicholas Kaldor (1966) proposed three famous economic laws and coined the term “Kaldor’s laws” to explain economic growth in the United Kingdom. The first law states that faster growth of manufacturing will accelerate the growth of GDP, due both to the fact that manufacturing is a substantial component of GDP and to the induced productivity growth effects on the overall economy. The second law, known as the “Verdoorn-Kaldor” law, first discovered by a Dutch economist P.J. Verdoorn (Verdoorn, 1949), provided evidence that the long-run rate of growth of output, usually for the manufacturing or industrial sector, causes the rate of growth of labor productivity, as a result of substantial increasing returns to scale<sup>28</sup>. In addition, this law is a key ingredient for the cumulative causation model accounting for the fact that the economic growth rate has remained high over time in “advanced manufacturing” regions. The third law refers to a statistical relationship that says that productivity growth is positively correlated with the growth of manufacturing employment and

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<sup>28</sup> Apart from this demand-led productivity growth, there are other discussions on the issue of the determinant of productive growth. Regarding the wage share or wages as a push variable, some economists argue that real wages will increase due to the low employment and rising bargaining power of labor unions and this will undoubtedly generate an increasing wage share and falling profit share, encouraging firms’ effort to accelerate the technological diffusion and productivity growth. (Hick, 1932; Dutt, 2006). However, the analysis of this topic lies outside the scope of the present paper. Our focus here is entirely on the “Verdoorn-Kaldor” law.

negatively related to the growth of non-manufacturing employment. The rationale is that migration of surplus labor from the agriculture or service sectors to industrial sectors typically increases the productivity growth of the rest of the economy. This is very similar to the “Verdoorn-Kaldor” law because both of them can be explained by the presence of increasing returns. Empirically speaking, however, there is nothing new suggested by the third law due to “a misspecified identity with the degree of bias resulting from the relationships given by the first two laws.” (McCombie, 2002, p. 88) Thus, we review and examine Kaldor’s first two laws in this paper.

Although some researchers have questioned the causality and validity of Kaldor’s laws (Rowthorn, 1975a, 1975b), a number of studies conducted at the international (McCombie, 1983, McCombie and Thirlwall, 1994), domestic (United Kingdom, Stoneman, 1979; Turkey, Bairam, 1991; the United States, Atesoglu, 1993; Italy, Ryzhenkov, 2006) and regional levels (the United States, Bernat, 1996; Europe, Pons-Novell, 1997; Spain, Leon-Ledesma, 2000, Greece, Alexiadis and Tsagdis, 2006) provide strong support for Kaldor’s laws.

Few economists have applied Kaldor’s laws to the case of China, especially in recent years. Hansen and Zhang’s paper (1996), using cross-sectional data between 1985 and 1991 without any control for a possible estimation bias caused by spatial autocorrelation, was the only major published study which assessed the adaptability of Kaldor’s laws to the Chinese economy. Researchers show that there have been more interactions between Chinese regions, particularly after the establishment of five special economic zones (Kojima, 1995; Rima, 2004). Thus, it is helpful to take into

account spatial effects across regions to describe the industrialization and urbanization process in China.

The purpose of this paper is to test for the validity of Kaldor's first two laws in 29 Chinese regions during the period of 1986 to 2007. The entire period is divided into two sub-periods, 1986 to 1996 and 1996 to 2007, to form the panel structure. Spatial econometrics is also used to control for possible spatial distortion. In the next section, we briefly review Kaldor's growth theory in the context of his first two laws and we present relevant discussions. The third section analyzes Chinese economic experiences and argues that China's growth practices are in accordance with Kaldor's laws. In the fourth section, we introduce spatial econometrics and modify the specification and estimation of our models accordingly. The last section presents the empirical evidence and its implications.

## **2.2 Economic growth and Kaldor's laws**

Traditional macroeconomic growth models relied heavily on presumptions of labor and resources scarcity, stressing that growth can be explained by exogenous technology and population growth. This scarcity therefore, not only allows for an optimal solution to the problem of the allocation of available endowments, but also generates an impediment to economic growth. As a consequence of neoclassical assumptions and interpretations, economic growth is supply-constrained. Contrary to the neoclassical view, long before the revival of classical growth theory through the development of new endogenous growth models (P. Romer, 1986; Lucas, 1988),

Kaldor questioned traditional assumptions of constant returns to scale, perfect competition and supply-constrained economic growth. He questioned the assumption that perfect competition only arises when production costs are the same no matter how large the rate of production. Apart from this, he asserted the existence of diminishing returns in agriculture and increasing returns in industry. Impediments to industrial growth caused by scarce resources would be eliminated by the acceleration of technological progress which would be “land-saving”<sup>29</sup> and “labor-saving”. He asserted that the “Law of Diminishing Returns” would not materialize since “such an approach (Classical economic growth model) is only valid in a universal context — where it refers to the whole production activity of a closed or self-contained system, which has no ‘real world’ analogy except when the economy of the world is considered as a whole. It is not a valid assumption for analyzing the economy of a single region.” (Kaldor, 1989, p. 32)

Increasing returns is the core of Kaldor’s industrial trade theory. New Keynesian economists such as Krugman (1979, 1991, 1995) and P. Romer (1986, 1987) provided insights similar to those of Kaldor, supporting the theory of increasing returns, but within general equilibrium models, a method which has always been questioned by Kaldor. Krugman in particular has made seminal contributions to new trade theory and economic geography, relying on imperfect competition and increasing returns to scale to discuss trade patterns. His skepticism on comparative cost theory and constant returns to scale can be traced back to three decades ago. Krugman (1979, p. 950)

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<sup>29</sup> Or more accurately, natural resource-saving.

undermined the conventional assumption of perfect competition by assuming monopolistic competition and claiming that “increasing returns produce trade and gains from trade even if economies have identical tastes, technology and factor endowments”. His subsequent studies also shed light on the causes of the geographical concentration of manufacturing (Krugman 1991, 1995). He argued that a higher proportion of income spent on non-agricultural products, economies of large-scale production and low transportation costs lead to the concentration of manufacturing. Surplus labour is attracted to the industry sector by ‘the large local market’ and ‘the availability of the goods and services’ (Krugman, 1991, p. 487).

Under the condition of increasing returns and free trade, industrially developed regions with higher productivity generate further price competitive advantages and attract vast immigration from surrounding or more distant areas where labor surplus exists. The induced unlimited labor supply, capital accumulation, and technological progress cause even further improvements of productivity and hence competitive advantages. This virtuous circle, in turn, creates a tendency toward the urbanization and concentration of industrial development. Meanwhile, industries in developing regions become uncompetitive as a consequence and are forced to specialize in the production and export of raw materials, minerals and low value-added goods. As a result, developing regions are shackled by primary production: productivity remains at a low level; the outflow of labor means limited employment capacity to upgrade industries; and products are poorly competitive, resulting in poverty and disparity. This framework, first explored by Swedish economist Gunnar Myrdal (1944), who

called this “the principle of circular and cumulative causation”, which Kaldor (1966) referred to as the “polarization process”, enhances the growth of industrially-developed regions by sacrificing the industrial development of developing regions, and it explains why growth differed and income inequalities worsened across regions during the post-war period. “Owing to increasing returns in processing activities (in manufactures) success breeds further success and failure begets more failure.” (Kaldor, 1989, p. 204)

The negative effect induced by the cumulative causation would be counteracted by the successful spread of industrialization to developing regions. This “trickle-down effect” matters only if new technology is imitated and adopted in the production process to improve productivity of the manufacturing sector by developing regions. This increase in productivity, in turn, generates economies of scale, prompts the economic growth and therefore creates a virtuous circle and catch-up growth in poor regions. Thus, whether the difference in growth rates between developed regions and developing regions is larger or smaller depends on “the interaction between these forces — i.e. that of polarization which leads to concentration of development in successful areas and of imitation or emulation which leads to the spread of industrialization into a wider range of areas.” (Kaldor, 1989, p. 206)

Economic growth is always demand-led, rather than supply or resource constrained. On one hand, resources such as capital and labor cannot account for the economic growth because of factor mobility, non-optimal allocation and demand-induced industrial capacity (Kaldor, 1989). On the other hand, exogenous

demand (or effective demand) determines how much potential resource is efficiently utilized and what the total output and employment will be (Keynes, 1936). This kind of demand, characterized by food demand or agricultural demand at the early stages of industrialization, has become export-driven demand, producing accelerator effects on output growth through the Harrod foreign trade multiplier. Various empirical observations have proved that fast economic growth in industrially-developed countries (e.g., Japan and Germany) or in developing countries (e.g., China and India) is caused by the combination of high income elasticities of world exports and low elasticities of domestic imports. Proper government interventions such as tariffs or subsidies are always required to favor the development of export potential.

Kaldor's laws were based on empirical findings to test his growth theory, all of which focused on the manufacturing or industrial sector. The first law asserts that manufacturing plays an elemental role in economic growth as attested by the strong empirical correlation between output growth ( $q$ ) and manufacturing growth ( $m$ ) using cross sectional data of twelve developed countries over the period 1950-65 (Kaldor, 1966):

$$q = 1.153 + 0.614 m \quad r^2 = 0.959 \quad (1)$$

(0.040)

where  $q$  and  $m$  are the growth rates of total output and manufacturing, and where the number in parentheses is standard error.

Specification (1) is always rewritten as specification (2) and (3) to express the relationship between the rate of economic growth and the excess of manufacturing

growth rate over non-manufacturing growth rate, so as to avoid the possibility of spurious correlation arising from manufacturing being a large component of GDP.

These alternative specifications are also confirmed by empirical results:

$$q = 3.351 + 0.954 (m - nm) \quad r^2 = 0.562 \quad (2)$$

(0.267)

$$nm = 1.142 + 0.55 m \quad r^2 = 0.824 \quad (3)$$

(0.08)

where  $nm$  is the growth rate of the non-manufacturing sector.

All three different specifications present similar empirical results: developed countries which have high income and output growth rates are associated with an advanced manufacturing sector and large-scale exports of manufacturing. Kaldor underlined the significance of the role of the manufacturing sector partly because he objected to those who apply the same set of assumptions to all sectors of the economy without regard to “the differences in technology, the type of market structure and the nature of competition as between the primary, secondary and tertiary sectors of the economy” and partly because “the Keynesian type of analysis in which effective demand plays a leading role is really a theory relating to Industry (which is largely the manufacturing sector)” (Kaldor, 1989, p. 33). It is manufacturing activities, combined with increasing returns to scale, that satisfy a substantial proportion of domestic and export demand, create factor mobility and industrial regional agglomerations through the cumulative causation process, and generate the growing differences in productivity and output across regions.

Kaldor's second law, also called the Verdoorn-Kaldor law, refers to the strong correlation between the growth of productivity and manufacturing growth through the effect of increasing returns. Verdoorn suggested a statistically long-run relationship between the growth of labor productivity and the growth rate of industrial production employing cross country data for the periods of 1870 to 1914 and 1914 to 1930. He found an average regression coefficient of approximately 0.45, a coefficient which is usually called the "Verdoorn coefficient" ( $\lambda$ ). This means that a 10% increase in the growth of industrial output tends to be associated with an average 4.5% increase in the growth of industrial productivity (Verdoorn, 1949). Kaldor confirmed Verdoorn's evidence by providing the following empirical relationship:

$$pm = a + \lambda m = 1.035 + 0.484 m \quad r^2 = 0.826 \quad (4)$$

(0.07)

where  $pm$  is the growth rate of manufacturing productivity. This relationship is usually re-specified as equation (5) because manufacturing productivity can always be rewritten as  $pm \equiv m - em$ , where  $em$  is the growth rate of manufacturing employment.

$$em = a + bm = -1.028 + 0.516 m \quad r^2 = 0.844 \quad (5)$$

(0.07)

The empirical evidence uncovered by Kaldor demonstrates that there exists substantial increasing returns to scale. This can be assessed from both equations (5) above and (6) below. The degree of returns to scale can be assessed as:  $v = \Delta m / \Delta em$ , that is the change in the growth of manufacturing output divided by the change in the

growth of manufacturing employment. The degree of returns to scale can thus be directly estimated as the inverse of the  $b$  coefficient in equation (5), so that  $v = 1/b = 1.94$ ; or it can be estimated from equation (4), as  $v = 1/(1-\lambda) = 1/(1-0.484) = 1.94$  since we know that  $em = m - pm$ .

Some economists incorporated the growth rate of the capital stock,  $k$ , into the analysis of increasing returns, especially if the analysis was derived from a Cobb-Douglas production function (Leon-Ledesma, 2000; McCombie, 2002). This relationship can be specified as:

$$pm = a + b_1m + b_2k \quad (6)$$

However, this relationship is rarely put to the test because of Kaldor's stylized fact of a constant capital-output ratio and the endogeneity of capital accumulation. Instead, equation (6) is rewritten either as equation (4) by substituting  $k = m$  into equation (6), or as equation (7) by endogenizing  $k$  by constructing the dependent variable  $t\hat{i} = w*em + (1-w)*k$ .

$$t\hat{i} = a + bm \quad (7)$$

where  $t\hat{i}$  is the growth rate of total factor inputs and  $w$  and  $(1-w)$  are the shares of labor and capital in total income (McCombie and de Riddler, 1984; Leon-Ledesma, 2000). This relationship is plausible since the growth rate of the capital stock is a

function of output growth as Kaldor (1970, p. 339) argued: “It is as sensible – or perhaps more sensible – to say that capital accumulation results from economic development as that it is a cause of development. Anyhow the two proceed side by side.”

Kaldor emphasized that industrial growth is exogenous in this relationship because this factor is determined by the demand-induced growth of the economy which is also exogenously driven. He attributed the relationship of economies of scale with increasing returns to technological progress and “learning by doing” since the use of new types of machinery, transportation and of new sources of energy not only improve productivity growth by means of saving labor, resources and capital but also by developing new markets (Kaldor, 1989). He argued that Verdoorn’s Law captures this dynamic relationship, which goes beyond the more standard static effects of large-scale production<sup>30</sup>: “It is a dynamic rather than a static relationship – between the rates of change of productivity and output, rather than between the level of productivity and the scale of output rather than between the level of productivity and the scale of output – primarily because technological progress enters into it, and is not just a reflection of the economies of large-scale production.” (Kaldor, 1966, p. 10) However, his interpretation of Verdoorn’s law was criticized by Rowthorn (1975), who cast doubt on the “learning by doing” dynamic nature of this relationship as well

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<sup>30</sup> Some authors used levels instead of growth rates to estimate the Verdoorn coefficient (McCombie, 1982a, McCombie and de Ridder, 1984) but their results of constant returns to scale contrasted with what they found in a dynamic relationship. This paradox has not been completely resolved so far. In our paper, we focus on the dynamic relationship because of “Kaldor’s insistence on the importance of the rate of growth in the Verdoorn Law” (McCombie et al., 2002, p. 99)

as the direction of causality of the relationship. Rowthorn noted that the growth of employment caused industrial growth because Kaldor's explanation of the slow industrial growth rate in the UK in his Inaugural Lecture was the shortage of labor from "economic maturity". In other words, economic growth is resource constrained and in this sense, the effects of increasing returns to scale only benefit those countries which have substantial unemployment. This argument of productivity-led economic growth has gained much popularity in mainstream economics<sup>31</sup>.

Nevertheless, Kaldor (1975, p. 895), although he conceded his error on the interpretation of the cause of the low rate of manufacturing growth, thought that "the United Kingdom had attained the stage of "economic maturity" and that her comparatively poor performance was to be explained by her inability to recruit enough labour to manufacturing industries rather than by poor market performance due to a lack of international competitiveness". Kaldor regarded Rowthorn's argument as a "misrepresentation" and a "misunderstanding", because the substantial role of the manufacturing sector in explaining total output growth implied that "the labor absorbed in manufacturing in the course of industrialization does not diminish production in the rest of the economy, owing to the existence of surplus labor in agriculture which is only eliminated at a late stage of industrial development, at the stage of 'economic maturity'."

Besides, Rowthorn's point of view seems to be untenable, based on previous

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<sup>31</sup> Rowthorn estimated the reverse causality:  $q = a + bl$ , because he argued that employment growth is the determinant of output growth and concluded that Kaldor's specification and estimation was "unconventional" and "seriously misleading", thus resulting in unreliable empirical findings.

insights in the history of economic thought. . Adam Smith (1998, p. 11) stated “the part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labor”. Allyn Young (1928, p. 529) supported this view, arguing that “the division of labor depends upon the extent of the market to be one of the most illuminating and fruitful generalizations to be found anywhere in the whole literature of economics.” Therefore, the growth of production in the context of an increase in the extent of the market leads to the growth of productivity, as a consequence of an improvement in the division of labor, which, in turn, further increases production. The interaction was depicted by Kaldor (1972, p. 1249) as follows: “It is a hen-and-egg question whether historically it was the growth of commerce which continually enlarged ‘the size of the market’ and thereby enabled increasing returns to be realized, or whether it was the improvement of techniques of production and the improvement of communication which led to the growth of commerce. In the process of the development of capitalism the two operated side by side.” Although the simultaneity problem first noted by Rowthorn raised much debate between Rowthorn and Kaldor, while testing for Rowthorn’s equation provides an evaluation of Verdoorn’s law, it does not resolve the endogeneity of output growth and employment growth in a process of cumulative causation since two variables interact with each other in such a process. VAR models, which are supposed to be a useful method to capture interactions, cannot be employed in our case because of the data problem (only 2 time periods). Another obvious way to solve this problem is to use instrumental variables. However, this method also suffers from controversies

regarding the selection of proper instruments and the identification of exact exogenous variables.

Unfortunately, some empirical findings show that Kaldor's laws are not as empirically solid as they used to be, due in part to the diminishing importance of the manufacturing sector caused by the rise of the service sector, notably by the rise of the financial service sector. It is thus believed, to some extent, that these laws are not valid over a prolonged period. As Verdoorn (1980, p. 385) himself argued: "the 'law' that has been given my name appears therefore to be much less generally valid than I was led to believe in 1949". We thus move to the next section, where we examine whether Kaldor's laws are outdated or not in the case of the Chinese economy.

### **2.3 The Chinese case during the 1985-2007 period<sup>32</sup>**

Before the economic reform in the late 1970s, Chinese economic growth relied heavily on the agricultural sector. Industrial development was more likely to mimic "Soviet-style" rule: heavy industries, especially military-oriented ones planned by central government, were dominant. These were not demand-induced industries, but rather could be characterized as resource-consuming with low efficiency. Small and mid-sized firms, as well as private or foreign firms were not allowed to operate. Most large-scale state-owned firms were located in the central regions and northeast regions because of resource utilization and national security. This situation totally changed after the implementation of the agrarian reform and open-door policy.

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<sup>32</sup> All statistics in this section are obtained from Statistics Bureau of China

Agrarian reform not only increased the output and productivity of the primary sector but it also produced a huge amount of rural surplus labor. Meanwhile, open-door policies got export growth going and it induced an inflow of direct foreign investment which led to the appearance of export-centered industries and the transfer of surplus labor from the rest of the economy into the industrial sector (Figure 2.1). Since then, new industrial enterprises mainly located in the eastern coastal area have flourished while the sector grew at a relatively low speed in central and western regions where the leading objective of provincial governments becomes that of increasing agricultural output.

Growth of export-led industries was enhanced after China's entrance to the World Trade Organization (WTO) as China's government recognized that globalization had been an irreversible trend. Trade reforms, as a part of the process of market-orientation and privatization, brought substantial gains to China, especially in the field of manufacturing. Low value-added manufacturing industries such as toys, shoes, apparels and household appliances expanded quickly due to the release of restraints on domestic demand and due to export demand. Referring to Figure 2.2, there are similar patterns between fluctuations of real GDP growth and real industrial growth and the latter always exhibits a wider variation than the former. Thus, industrial growth is strongly and positively associated with total output growth. For the sake of comparison, the real growth rate of exports is added in Figure 3. We find that the volatility of export growth is much larger than that of the other two growth rates, though all three growth rates exhibit a similar trend. Growth of industrial output

and GDP is closely accompanied by export growth and external demand is claimed to be a major barometer of the Chinese economy.

Figure 2.1: Proportion of Urban and Rural Population in 1985 and 2007

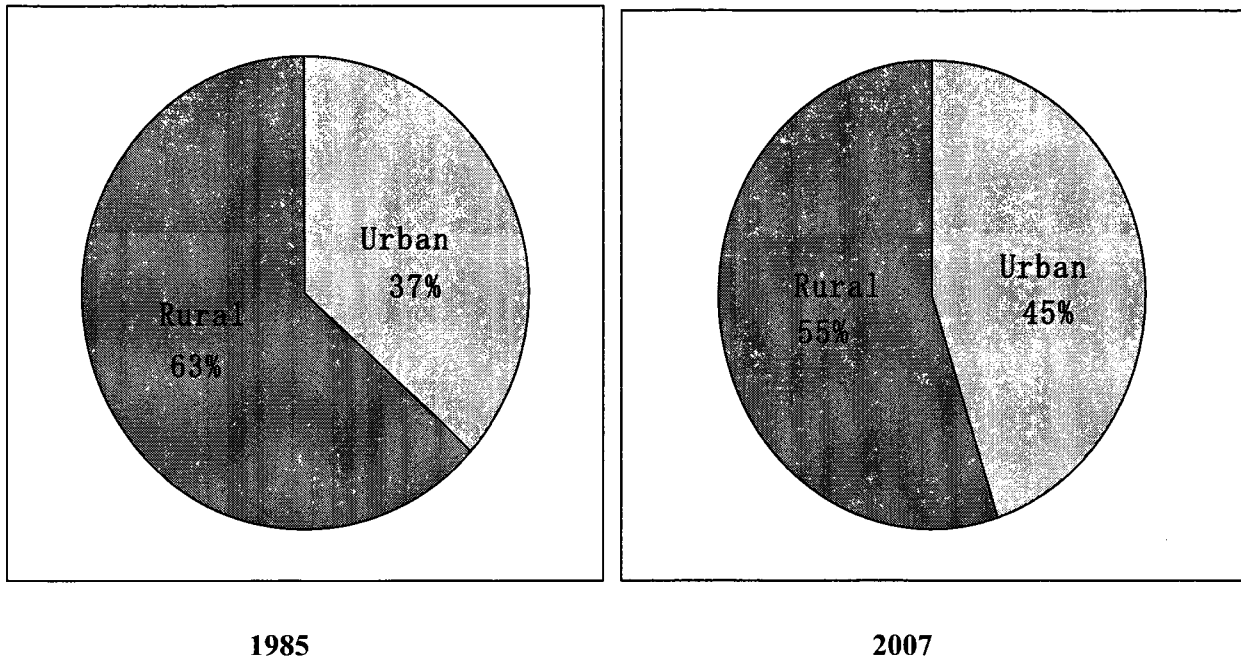


Figure 2.2: Real growth rate of GDP and Industrial output between 1986 and 2007

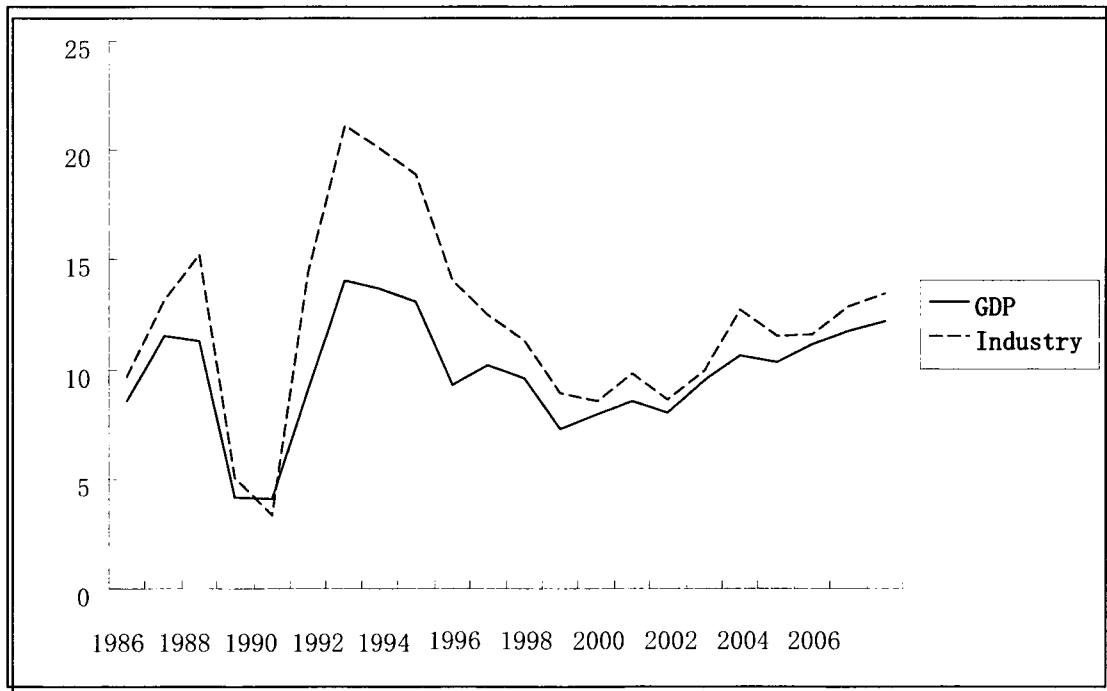
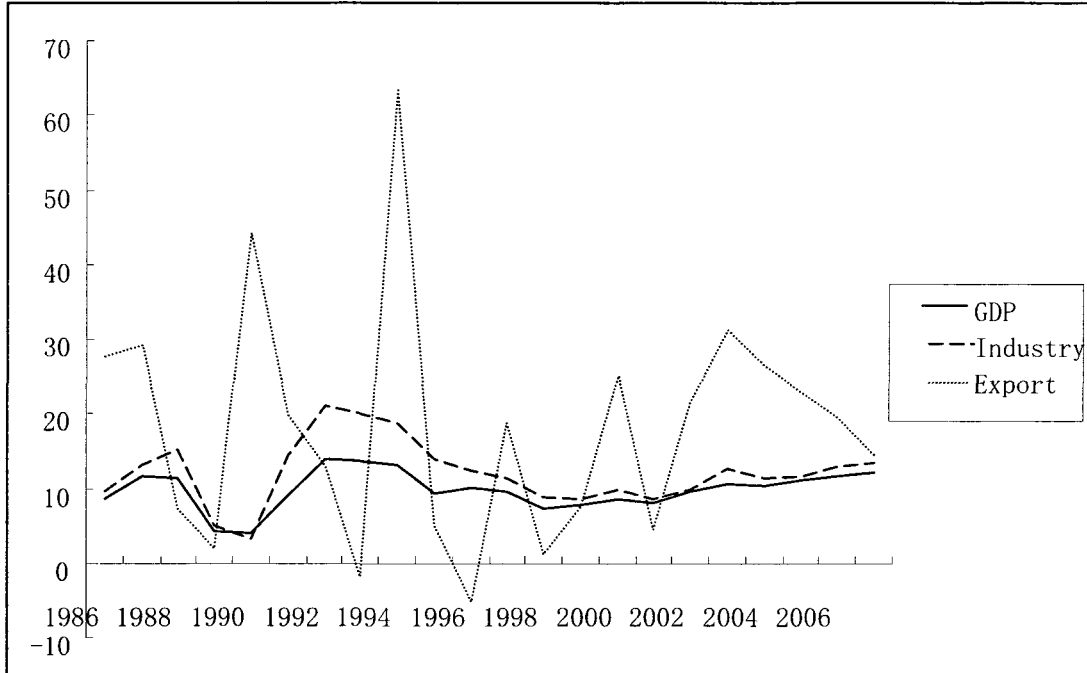


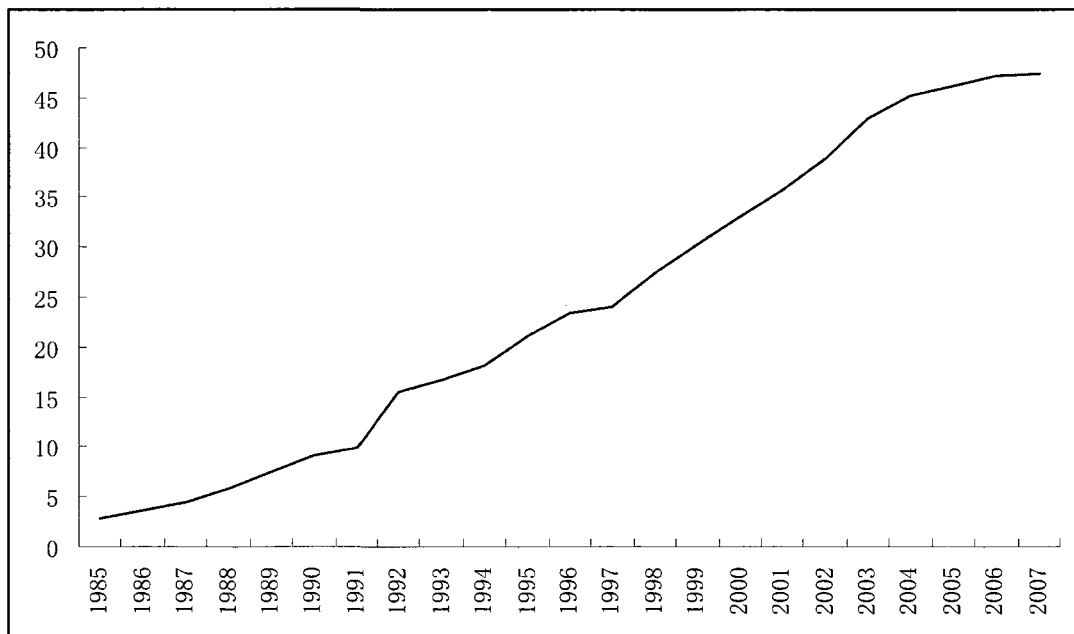
Figure 2.3: Real growth rates of GDP, industrial output and export



According to the Heckscher-Ohlin factor content principle (Heckscher and Ohlin, 1991), a country's trade patterns are based on its factor endowments. China would thus be expected to specialize in exporting low-skilled labour intensive products such as primary products, raw materials and low value-added products and in importing capital and high value-added products because of its greater labor supply with relatively lower costs than capital. However, this classical concept of trade theory seems counterfactual in China. Apart from the rapid export growth of low value-added products, labor division and technology diffusion also prompted the export of mid-high value-added products. The relatively high value-added machinery and transport equipment illustrates this: the average real growth rate of the exports of these kinds of products is roughly 28.4% during the period 1986-2007 and their share

in total exports keeps rising fast as indicated by Figure 2.4. Contrary to Heckscher-Ohlin's prediction, China, following an "outward strategy", owed its spectacular economic growth both to a high foreign world income elasticity of demand for its exports and a low income elasticity of demand for manufactured imports. In this process, the exports of low value-added and price competitive goods has helped China to achieve important and rapid gains which induced capital accumulation and direct foreign investment in the manufacturing sector. This led to high-tech imitation and an increase in human capital, which in turn led to an upgrade in the industrial hierarchy of production, towards capital and technology intensive production, thus further stimulating export and income growth, with the help of increasing returns to scale.

Figure 2.4: The share of export of medium-high value-added machinery and transport equipment to total exports



In terms of a regional perspective of economic development, there are 31 regions in mainland China, including 27 provinces and administrative autonomies and 4 municipalities. These regions were grouped into three economic belts since 1986: the eastern coastal area; the central area; and the western area. Three special economic zones – the Special Economic Zone of Pearl River Delta, the Special Economic Zone of the Yangtse Delta, and the Circum-Bohai Economic Zone were constructed successively, consisting of 12 provinces and municipalities, most of which lie in the eastern coastal area (Table 2.1). The eastern coastal area is thus the leading growth area of China where the vast majority of manufacturing enterprises are located. The establishment of special economic zones and favorable trade policies has facilitated foreign investment on technology embodied industries with large externalities, such as IT, advanced manufacturing, bioengineering and aviation, where more efficient work practices are undertaken.

Labour is drawn from the central and western areas where labour productivity is low, moving into industries in the eastern coastal area where labour productivity is higher. While this migration improves the overall Chinese productivity, it probably further dampens the industrial development in the central and western areas. The lack of capital and of overseas orders makes it difficult to develop advanced industries and makes these areas specialize in the production of agriculture, raw materials, minerals and light industries, all of which provide limited employment potential. According to Figure 2.5, the average level of regional industrial output in eastern areas grows faster than its central and western counterparts and the disparity tends to become larger. The

contribution of each economic belt to the overall economy can also be shown by Figure 2.6: industry in the coastal area consists of a large proportion of total industry and exports in that area consist of an extremely large proportion of total exports.

This might explain the large regional growth disparities in China. Economic growth in the central and western areas is dependent on sectors like agriculture and construction, which exhibit constant or diminishing returns. Most of the male labor force transfers to the coastal belt, leaving females and children home, thus depressing the potential for industrial development, but the remittances that these workers were sending back home is far less than what is needed to maintain regional GDP growth. The rise of manufacturing productivity in the coastal area generates large enough capacities to satisfy export demand, but this somewhat crowds out opportunities for other areas. Disparities in labour productivity per region is thus not so much the consequence of low productivity in the agricultural or construction sectors of the central and western belts, but rather it is caused by the limited aggregate demand for the products of the 'profitable' industries of these two areas, as well as their limited capital and employment capacity. This vicious circle would be accelerated through the effect of increasing returns of industries in the coastal area were it not for central government intervention.

## **2.4 Empirical tests**

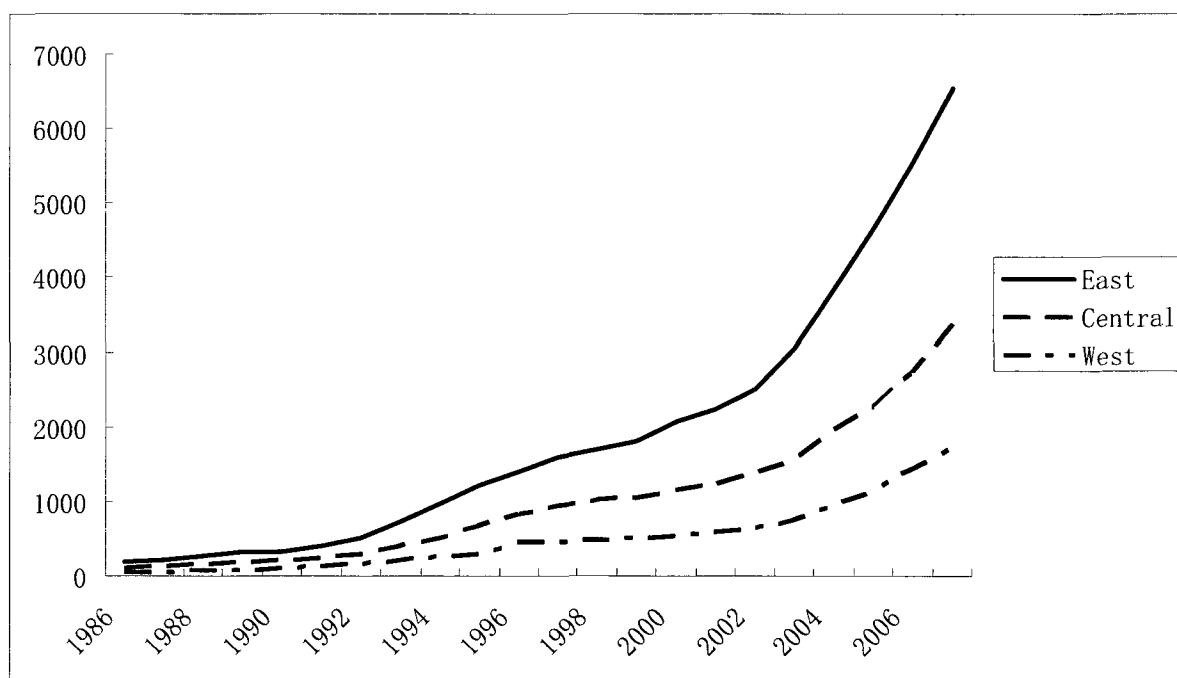
### **Spatial estimation methods**

According to regional science theory, economic agents' decisions can somehow be related to location and distance between regions. Regional studies based on traditional

Table 2.1: China's three economic belts and related special economic zones<sup>33</sup>

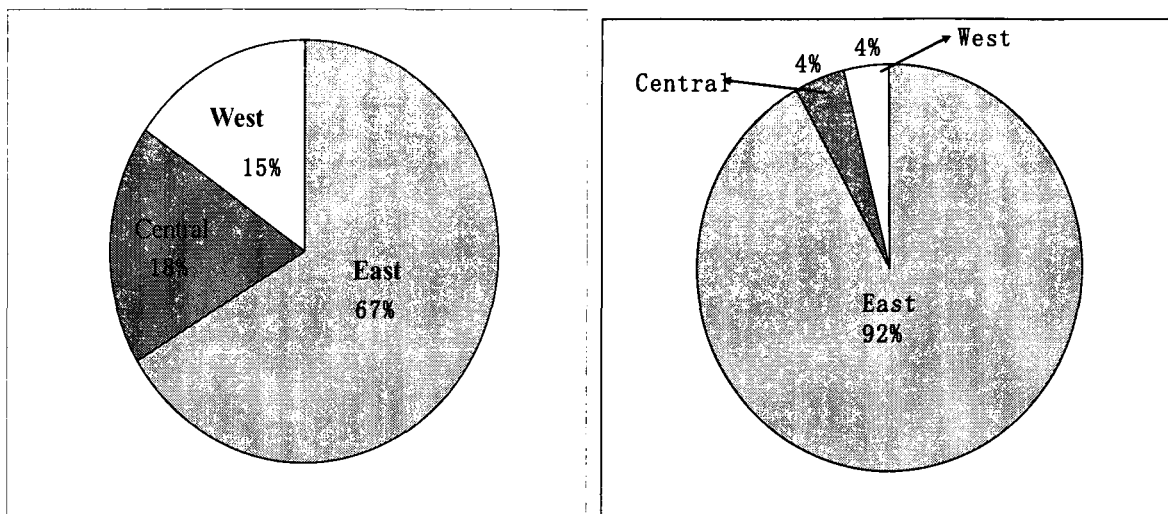
East (12 provinces and municipalities)	Central (9 provinces)	West (10 provinces and municipalities)
Beijing***	Shanxi***	Sichuan
Tianjin***	Inner Mongolia***	Guizhou
Hebei***	Jilin	Yunnan
Liaoning***	Heilongjiang	Tibet
Shanghai**	Anhui	Shannxi
Jiangsu**	Jiangxi	Gansu
Zhejiang**	Henan	Ningxia
Fujian*	Hubei	Xinjiang
Shandong***	Hunan	Chongqing
Guangdong*		Qinghai
Guangxi		
Hainan		

Figure 2.5: Average level of regional industrial output in the three economic belts



<sup>33</sup> \* indicates that the city belongs to the Special Economic Zone of the Pearl River Delta; \*\* that the city belongs to the Special Economic Zone of the Yangtze Delta; and \*\*\* that the city belongs to the Circum-Bohai Economic Zone

Figure 2.6: Share of industrial output (left) and share of export (right) for each economic belt in 2007.



econometrics ignore two problems arising when regional economies are subject to spatial dependence and spatial heterogeneity. Spatial dependence results from the dependence between sample data from different locations. This violates one of the Gauss-Markov assumptions used in conventional OLS regression, which says that explanatory variables are fixed in repeated sampling. Spatial heterogeneity arises when regional data can somehow be related to geographic locations and distances so that coefficients are not homogenous across spatial units. This violates the assumption of homoscedasticity and nonautocorrelation (Paelinck and Klaassen, 1979; Cliff and Ord, 1981; Anselin, 1988a, 2001b).

Spatial effects arising from spatial dependence are usually incorporated via two models: the spatial-lag model and the spatial-error model. Both models differentiate whether spatial characteristics of the sample data follow the spillover or stochastic process. The spatial-lag model includes a spatial lag operator on the right-hand side of

the specification. This new variable describes the interactions between neighboring observations, and it is specified as follows:

$$Y = \rho \mathbf{W} Y + \mathbf{X}\beta + \varepsilon \quad (8)$$

where  $Y$  and  $X$  are vectors of regional observations of endogenous and exogenous variables and  $\varepsilon$  is the error term;  $\mathbf{W}$  is the spatial-weights matrix which is the key to capture the link between regions. In this paper, we use a simple binary spatial-weights matrix, with  $w_{ij} = 1$  when regions  $i$  and  $j$  are contiguous and 0 otherwise,<sup>34</sup> while  $\rho$  is the spatial autoregressive coefficient which explains how much the dependent variable in the neighboring regions is varied by a unitary change in this variable in a given region. This spatial effect is independent of the effects of other exogenous variables. In this case, OLS estimations of  $\beta$  which have not taken into account spatial autocorrelation will lead to bias and inefficiency.

The spatial-error model formulates spatial interaction with error terms, which can be specified as:

$$Y = \mathbf{X}\beta + \varepsilon, \quad (9)$$

$$\varepsilon = \theta \mathbf{W}\varepsilon + \mathbf{u} = (\mathbf{I} - \theta \mathbf{W})^{-1} \mathbf{u} \quad (10)$$

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<sup>34</sup>  $W_{i,j}$  also takes the value 1 when regions are located in one special economic zone though they do not present a common border, because they share the same favorable investment policies and the linkage between each other is significant.

where  $\theta$  is the autoregressive parameter and  $u$  is assumed to be distributed independently across regions with constant variance. This model presents spatial dependence with error terms, capturing the diffusion process of the effects of a random shock from a given region to surrounding regions. The spatial term matters only to the extent that  $y_i$  is above or below its “normal” level as predicted by equation (9) (Bernat, 1996). Consequently, “each region is viewed not as an independent unit but, rather, as a functional unit-member of a complex geographical system.” (Alexiadis and Tsagdis, 2006, p. 160) This arises since the region is defined on the basis of administrative or political criteria rather than economic ones, so that the residuals of the neighboring regions are serially correlated. Invalid inferences occur in this case because coefficient estimates have poor efficiency, though, unlike the spatial-lag model, they are unbiased.

Although application of spatial econometrics in cross-sectional data is of interest, a range of issues concerned with panel data has been increasingly cited in recent literature because in contrast to time series, panel data contains more information, variation and less collinearity, thus providing larger degrees of freedom and more efficiency (Baltagi 2001; Elhorst, 2003). Specifications of Kaldor’s laws to be tested incorporating the spatial terms are modified as follows:

OLS estimation methods for these models are inappropriate since the incorporation of spatial effects invalidates inferences and results. Maximum likelihood estimation is usually carried out to overcome these problems which are adopted in our tests (Ord, 1975; Anselin, 1988a). Furthermore, we limit the discussion on the spatial

Table 2.2: Specifications of Kaldor's laws with spatial terms

	Spatial dependence model	Spatial error model
Kaldor's first law	$g = \rho \mathbf{W} g + \alpha + m\beta + \varepsilon$ (1.1)	$g = \alpha + \beta m + (\mathbf{I} - \theta \mathbf{W})^{-1} \mathbf{u}$ (1.2)
	$g = \rho \mathbf{W} g + \alpha + \beta(m - nm) + \varepsilon$ (2.1)	$g = \alpha + \beta(m - nm) + (\mathbf{I} - \theta \mathbf{W})^{-1} \mathbf{u}$ (2.2)
	$nm = \rho \mathbf{W} nm + \alpha + \beta m + \varepsilon$ (3.1)	$nm = \alpha + \beta m + (\theta \mathbf{I} - \mathbf{W})^{-1} \mathbf{u}$ (3.2)
Verdoorn's law	$em = \rho \mathbf{W} em + \alpha + \beta m + \varepsilon$ (5.1)	$em = \alpha + \beta m + (\mathbf{I} - \theta \mathbf{W})^{-1} \mathbf{u}$ (5.2)
	$tf = \rho \mathbf{W} tf + \alpha + \beta m + \varepsilon$ (7.1)	$tf = \alpha + \beta m + (\mathbf{I} - \theta \mathbf{W})^{-1} \mathbf{u}$ (7.2)

dependence in most of our tests since application of estimating spatial heterogeneity in the panel data context has been criticized by many researchers (Baltagi and Griffin, 1997; Quah, 1996b; Elhorst, 2003) and the estimation of the spatial heterogeneity “is only feasible when the number of observations on each spatial unit is large enough. Most panel data sets do not meet this requirement” (Elhorst, 2003, p. 245). However, since some econometricians argue that the presence of spatial heterogeneity can be handled by standard panel data methods such as spatial fixed effect (Anselin et al., 2008), we will only consider the possible heterogeneity problem when it is relevant to our regressions

## Data

Regional Data<sup>35</sup> for 29 provinces or municipalities<sup>36</sup> in China are obtained from the PRC Statistical Bureau<sup>37</sup> covering the years of 1986 to 2007. In this paper, we use 10 year spans instead of yearly observations, in order to reduce the influence of business cycles on error terms. The entire 22-year period is divided into 2 sub-periods of 1986 to 1996 and 1997 to 2007, thus building a panel dataset with a pool of the average growth rates. Referring to Figure 2.7, the Chinese economy experienced high volatility during the first subperiod, which covers a whole business cycle, and it experienced stable economic growth in the second subperiod.

Output is defined as the gross regional product. Manufacturing output is defined as value-added of the industrial sector which can also be expressed by the value-added of the industries of the secondary sector, with the exception of the construction industry<sup>38</sup>. Non-manufacturing output is calculated by taking the sum of the value-added of the non-manufacturing sectors or by taking total output and

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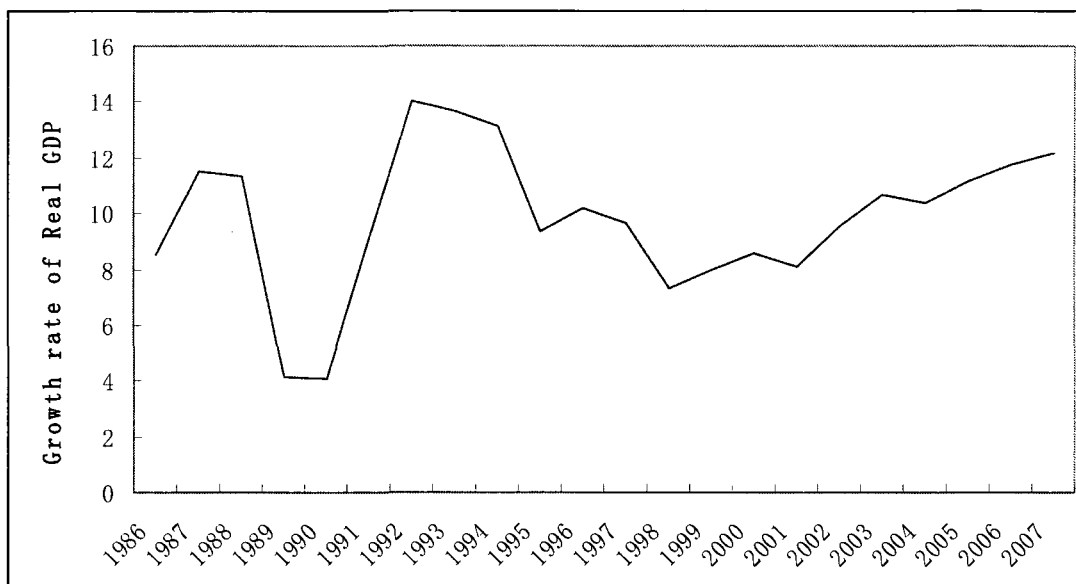
<sup>35</sup> Using regional data to test the laws will reduce the effects of difference in social factors and macroeconomic policies compared to cross country data, and will present conservative estimates. (McCombie, 2002)

<sup>36</sup> There are 23 provinces, 5 autonomous regions, 4 municipalities and 2 special administrative regions in China. Our data set excludes Tibet because of the unavailability of reliable data. Taiwan, Hong Kong and Macao are excluded as well, due to the differences in institution and economic evolution. Chongqing, separated from the Sichuan province, has become a municipality since 1997, but we add its data to Sichuan for the sake of simplicity.

<sup>37</sup> Most data is from the Statistical Yearbook of China, Volumes 1985 to 2007, published by the PRC Statistic Bureau.

<sup>38</sup> Most studies that checked for the validity of Kaldor's laws used secondary industry data which contains the construction industry data to represent the manufacturing sector, but the evidence of increasing returns in the construction sector is always shown to be weak or controversial because of the low rate of technical progress and the labour intensive production process in this sector. (Bianchi, 1998; Leon-Ledesma, 1998)

Figure 2.7: Growth rate of real GDP between 1986 and 2007



subtracting the value-added of the manufacturing sector. All data noted above are deflated to constant prices<sup>39</sup>. Employment is defined as the number of staff and workers at year-end performing the same activities, instead of the number of employed persons in the regional industrial sector, because of the unavailability of consistent statistics<sup>40</sup>. The real capital stock series are taken from Zhang et al.'s study on the estimation of real regional capital stock in China between 1952 and 2004 (Zhang et al., 2008)<sup>41</sup>. Because of the availability of data of key variables, such as

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<sup>39</sup> 1985=100

<sup>40</sup> These data were available until 2003, when data became available only for the number of employed persons in urban firms, thus omitting employees in rural firms. The main difference between the two definitions is that the former one does not include employees in rural and private firms, as well as self-employed and retired individuals. Considering the fact that industries rarely exist in these units and the consistency of the former data, we would expect the number of industrial staff and workers to be a better choice in the case of China.

<sup>41</sup> This series has been updated to the present.

regional capital stock, it is unnecessary to introduce proxies into our models to make adjustments.

Moreover, there are a few advantages in using regional data to deal with the simultaneity problem. Using regional data provides homogeneity of technology and of social-economic factors between regions and removes barriers to the flow of factors of production, so that economies are not subjected to supply constraint. In addition, price stability between regions within a country decreases the effect of productivity growth on output growth due to the weakness of price competitiveness. Hence, all these advantages substantially reduce the simultaneous equation bias (Leon-Ledesma, 2000; McCombie et al., 2002). As a consequence, we will not make any further attempt in reducing the simultaneity bias in our empirical estimations.<sup>42</sup>

### **Empirical results**

In the first place, we detect whether the disturbances of the regression model exhibit the spatial dependence pattern in each sub-period. A number of statistical tests can be used to test for the presence of spatial autocorrelation in the residuals: Moran's  $I$  – statistics, the LM error statistics and the Wald statistics are based on least square estimation while the LR is carried out by log likelihood function.

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<sup>42</sup> 2SLS estimation might be the best way to control for the simultaneity problem in our paper. However, there are a number of serious problems regarding the selection of instrument variables. Parikh (1978) used export growth and I/Q (Investment/Output) as instrument variables, but these instruments might affect productivity growth (dependent variable) directly, instead of through the effect of manufacturing growth (explanatory variable). McCombie and De Ridder (1984) chose lagged variables as instruments, but it could not be applied in our paper either since we only have two time periods.

Table 2.3: Results of tests for the presence of spatial autocorrelation<sup>43</sup>

1986-1996		1997-2007	
Moran's <i>I</i>	2.88 (0.003)	Moran's <i>I</i>	0.05 (0.956)
LM error	4.72 (0.030)	LM error	0.06 (0.801)
Wald	3.42 (0.064)	Wald	0.05 (0.827)
LR	4.67 (0.030)	LR	0.08 (0.779)

Table 2.3 indicates the rejection of the null hypothesis of no spatial correlation of regional data in the first subperiod at the 95% level of confidence.<sup>44</sup> This suggests that any change in the regional output growth due to a random shock on a given region will affect the regional output growth in the neighboring regions through an exogenous shock, and this effect spreads to their further regions as well. In other words, there is evidence of strong regional interactions in China. The market proximity in Chinese regions may arise from technological spillovers, labour migration, inter-regional trade, and information networks between administrative units and economically defined units. For example, Hering and Poncet's (2007) paper underlies the importance of bilateral trade and labour transfer on the shape of spatial patterns in China. Moreover, some studies show that the agglomeration of foreign direct investment (FDI) and its spillover effects contribute to the presence of spatial dependence in China (Coughlin and Segev, 2000). However, there is little or no

<sup>43</sup> These tests are based on equation (1). The number of observations for each period is 29. P-values are in parentheses.

<sup>44</sup> The statistics of the Wald test is significant at the 90% level of confidence.

spatial dependence in the residuals between 1997 and 2007. This means the “trickle-down effect” across developed and developing regions has been significantly reduced and thus to some extent implies greater divergence in regional inequality over the last few years.

At the outset of the economic reform 20 years ago, Deng (Chinese supreme government leader) espoused a policy stating, “Let some people or regions get rich first” so as to help others for common prosperity. This approach was quickly put into practice, and initially, it yielded impressive growth without large regional disparities. The spatial effect on Chinese regions can be described by two primary factors during this period. On one hand, the restructuring of low value-added manufacturing industries in the coastal regions and the relaxation of restrictions on labour mobility caused a large amount of surplus labour in the agricultural sector of central regions to migrate to coastal regions; this promoted economic growth in poor regions through the remittances that these workers were sending back home, in the central and western belts. On the other hand, without the constraints of a planned economy on supply and demand, the consumption goods mostly produced in central and western regions began to circulate across surrounding regions, thus stimulating households’ consumption and hence the output growth of these regions.

However, over the last decade, a large proportion of the income received by people working in richer regions started to be devoted to savings and investment in the housing and financial markets, and a smaller proportion of income went into remittances sent back to the poor regions. In addition, poor coordination between

regional governments and the depressing effects of lower primary product prices on the growth of central and western agricultural regions, brought by China's entrance into the WTO, may explain both the disappearance of spatial effects in the second sub-period in our sample data and the increasing regional disparities. Even so, we still cannot reject the possibility of the presence of spatial correlation in our panel dataset.

The following three tables show estimates of Kaldor's first law in the form of its three standard specifications, each involving three different estimates – an OLS estimation, a spatial-lag estimation and a spatial-error estimation, for the sake of comparison<sup>45</sup>.

Table 2.4: Results of testing for the first relationship of Kaldor's first law

Dependent variable: $g_{i,t}$			
	Non-spatial (1)	Spatial-lag (1.1)	Spatial-error (1.2)
Constant	3.560564 (0.0009)	-0.240961 (0.777230)	8.46043 (0.000000)
Industry	0.745249 (0.0000)	0.507215 (0.000000)	0.462905 (0.000000)
Spatial term		0.470982 (0.000000)	0.814993 (0.000000)
R <sup>2</sup>	0.769828	0.8877	0.8816
log-likelihood		-102.80064	-108.84103

<sup>45</sup> Given the results of Table 2.3, which show the presence of spatial autocorrelation in the first subperiod and its absence in the second subperiod, it would seem that it would be best to estimate regressions for each subperiod separately. However, the small number of cross-sectional observations (N=29) would overly reduce the reliability of such estimates. So this avenue will not be pursued here.

According to Table 2.4, the three equations dealing with the first relationship provide favorable evidence for Kaldor's first law. Regional industrial growth impacts regional output growth positively and significantly, and a greater proportion of variation in regional growth can be explained by variation in the industrial growth and spatial factors, as shown by the high value of the R-squared statistics. The significance of spatial terms in the spatial-lag model and the spatial error model demonstrates the presence of spatial dependence across regions. The value of the spatial dependence estimate, 0.47 in the spatial-lag model, indicates that 1% output growth in one region causes a 0.47% rise in the output growth of surrounding regions. Despite decreasing the influence of the industry sector on total output by a small amount<sup>46</sup>, this effect accounts for the improvement of the fit of the model since it increases the R-squared statistics by about 10% which means that 10% of the variation in regional output growth is explained by spatial dependence. However, the presence of a spurious relationship between industrial growth and total output growth in this specification, as noted above, may bias estimates and we turn to the analysis of the other two relationships which avoid this problem.

Table 2.5 presents interesting results compared to the above case. OLS estimation cannot find empirical evidence for this relationship of the first Kaldor's law, and the R-squared statistic is so low that regressors have no explanatory power. Nevertheless, results get totally changed once the spatial effects are incorporated. There exists a positive correlation between regional output growth and the excess of the regional

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<sup>46</sup> The value of industrial growth coefficient reduces from 0.74 in equation (1) to 0.5 and 0.46 in equation (2) and (3).

Table 2.5: Results of testing for the second relationship of Kaldor's first law

Dependent variable: $g_{i,t}$			
	Non-spatial (2)	Spatial-lag (2.1)	Spatial-error (2.2)
Constant	16.88911 ( 0.0000)	3.941929 (0.007124)	15.915078 (0.000000)
$m_{i,t} - nm_{i,t}$	0.039494 ( 0.7941)	0.145074 (0.075417)	0.197752 (0.007322)
Spatial term		0.746961 (0.000000)	0.836968 (0.000000)
R <sup>2</sup>	0.001227	0.698	0.7377
log-likelihood		-134.61605	-132.42365

Table 2.6: Results of testing for the third relationship of Kaldor's first law

Dependent variable: $nm_{i,t}$			
	Non-spatial (3)	Spatial-lag (3.1)	Spatial-error (3.2)
Constant	5.47019 ( 0.0013)	0.664179 ( 0.599849 )	13.609695 (0.000000)
Industry	0.621549 ( 0.0000)	0.282554 ( 0.000022 )	0.161806 ( 0.019982 )
Spatial term		0.651958 (0.000000)	0.854981 (0.000000)
R <sup>2</sup>	0.476576	0.7835	0.7877
log-likelihood		-126.96177	-130.1434

industrial growth over the non-industrial growth. Thus, Kaldor's first law in the form of this relationship can still be said to hold <sup>47</sup> provided we take into account the spatial effects. The R-squared statistic is also increased to present a moderate fit. This improvement is also shown in the third relationship, shown in Table 2.6. Empirical evidence shows that the sensitivity of regional growth to industrial growth is overestimated in the OLS estimation, as the estimate is biased upward as a result of the omission of the spatial effects. However, the first Kaldor's law still holds under this relationship.

Table 2.7: Results of testing for the first relationship of Kaldor's second law

Dependent variable: $em_{i,t}$			
	Non-spatial (5)	Spatial-lag (5.1)	Spatial-error (5.2)
Constant	-9.237207 (0.000000)	-4.881603 (0.000201)	-4.653951 (0.004573)
Industry	0.441574 (0.00001)	0.238628 (0.000409)	0.191086 (0.011030)
Spatial term		0.558950 (0.000000)	0.721997 (0.000000)
R <sup>2</sup>	0.3494	0.6350	0.6430
log-likelihood		-130.26454	-131.63493
$v = 1/b$	2.26	4.19	5.23
$\lambda = 1-b$	0.55842	0.76137	0.80892

<sup>47</sup> Industrial growth is moderately significant at the level of 90% confidence in the spatial-lag model, but highly significant at 99% confidence level in the spatial-error model.

Estimates for the Kaldor's second law or Verdoorn's law, equations (10), (11) and (12), are presented in Table 2.7. All the estimates of the size of returns to scale ( $v$ )<sup>48</sup> are significantly larger than unity at the 0.95 confidence level, which confirms the hypothesis of the endogeneity of productivity and substantial economies of scale. The incorporation of spatial autocorrelation is also highly significant and improves the fit according to the R-squared statistics. The conventional OLS results indicate that a 10% increase in the growth of industrial output would be associated with a 5.6% ( $\lambda$ )<sup>49</sup> increase in labour productivity and this amount has been commonly accepted by various studies. However, as with the case of Kaldor's first law, the value of the elasticity of productivity with respect to output is reduced<sup>50</sup> after taking into account the spatial term, as this value gets reduced from 0.44 to 0.24 and 0.19 respectively which means the degree of increasing returns to scale rises from 2.26 to 4.19 and 5.23 respectively. In addition, according to the estimate of the spatial-lag term, a 10% increase in the growth of productivity in neighboring regions would be associated with a 5.5% increase in the given region's industrial productivity. The relatively larger degree of increasing returns to scale after the incorporation of spatial effects might be accounted for by four factors: (1) low tech and low value-added manufacturing processes have been easily and rapidly diffused and imitated by neighboring regions which prompted innovation and productivity; (2) the widening of the extent of the market and the favourable policies for foreign investors and the inflow of DFI led to

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<sup>48</sup> As shown in the 8<sup>th</sup> row of Table 2.7, the size of scale return ( $v$ ) equals one divided by the amount of coefficient of the rate of manufacturing growth ( $v=1/b$ )

<sup>49</sup> As shown in the 9<sup>th</sup> row of Table 2.7, the size of Verdoorn coefficient  $\lambda = 1 - b$

<sup>50</sup> Note that the value of  $b$  and that of  $\lambda$  are negatively related:  $\lambda = 1 - b$

greater scope for the division of labour and knowledge learning, resulting in greater economies of scales and capital intensive manufacturing with embodied technological externalities growing much faster; (3) in the late 90s and early 2000s a large number of workers were laid off by the Chinese government, especially from state-owned firms, in an attempt to improve the competitiveness of its firms before joining the WTO, thus further increasing labour productivity and the degree of increasing returns; and (4) a measurement bias might occur, since the introduction of spatial terms always reduces the overestimation of coefficient estimates obtained through the conventional OLS method, and this in turn raises the scale of economies (i.e., if the growth rate of labour productivity is used as the dependent variable, instead of that of industrial employment, the industrial coefficient might be reduced as well, and economies of scale will in turn appear to be smaller).

Empirical results of Kaldor's second law based on the relationship relying on total factor productivity show few variations in estimates and inferences, as can be seen by inspecting Table 2.8. R-squared statistics of all three specifications are low, even though all estimates of regressors are significant. These poor fits, when incorporating the capital stock, might arise from the possibility of spatial heterogeneity since there are large differences in the amounts of capital stocks across Chinese regions. In order to overcome this problem, the spatial fixed effect model is used to capture spatial characteristics. Empirical evidence indicates that the goodness of fit of both spatial-lag and spatial-error models are much improved and the values of the new estimates are similar to what we found in the previous case (Table 2.7), thus

also providing strong support for the presence of increasing returns to scale and the Verdoorn-Kaldor Law.<sup>51</sup>

Table 2.8: Results of testing for the second relationship of Kaldor's second law<sup>52</sup>

Dependent variable: $t\hat{f}i_{i,t}$					
	Non-spatial (7)	Spatial-lag (7.1)		Spatial-error (7.2)	
		No fixed effect	Spatial fixed effect	No fixed effect	Spatial fixed effect
Constant	1.857457 (0.110382)	1.591447 (0.77723)		8.46043 (0.000000)	
Industry	0.182567 (0.004424)	0.205005 (0.018804)	0.170873 (0.000105)	0.462905 (0.000000)	0.172261 (0.000337)
Spatial term		0.187994 (0.273186)	0.313950 (0.026421)	0.814993 (0.000000)	0.325000 (0.038648)
R <sup>2</sup>	0.1358	0.1708	0.7521	0.1509	0.7254
log-likelihood		128.20509	-93.605023	-108.84103	-96.612374
$v = 1/b$	5.47744	4.877930	5.85230	2.16027	5.80514
$\lambda = 1-b$	0.81743	0.794995	0.82913	0.53709	0.82774

## 2.5 Conclusion and implications

This paper provides a review of the literature on Kaldor's laws and applies these laws to the case of the Chinese economy during the 1986 to 2007 period. The analysis of economic development in China during the last two decades is in accordance with what the law says: manufacturing is the engine of economic growth and the growth of

<sup>51</sup> When splitting the panel data into two cross-sectional samples (29 observations in each sample), empirical results for all models show that spatial terms are significant in the first period but non significant in the second period. This is consistent with the results indicated by Table 2.3. Again, there is no lasting trickle-down effect.

<sup>52</sup> The employment share is defined as one half, so is the capital share due to the unavailability of regional wage rate and due to McCombie and de Ridder's argument "the results proved insensitive to the exam magnitude chosen" (McCombie and de Ridder, 1984, p. 275)

industrial or manufacturing output causes the growth of industrial productivity. Empirical evidence, based on regional data, strongly supports the validity of Kaldor's laws and the presence of increasing returns to scale in the industrial sector. Our study also shows that regional data exhibits a significant spatial dependence pattern in all of the models, which is of importance for both empirical inference and economic intuition. On one hand, spatial dependence models in this paper address the potential invalidity and inefficiency of inference derived from OLS estimation due to the existence of spatial autocorrelation. On the other hand, the strong evidence of the presence of spatial dependence indicates that the economic growth of a given region will favor the growth of surrounding regions.

The contribution of this paper, aside from successfully testing for the validity of Kaldor's laws with a latest update of Chinese regional data, is the application of spatial panel econometric methods to the various relationships that define Kaldor's first and second laws, thus obtaining more reliable results. Apart from this, the paper shows the significance of the manufacturing sector for economic development, in contrast to some recent studies that seem to underline the importance of the financial and construction sectors. Our belief is that the surge of financial services and construction should be attributed to the growth of manufacturing. It would be inappropriate to sacrifice the substance for the shadow by emphasizing a reverse causation. Booms induced by finance seem to be temporary and an illusion, whereas the development of manufacturing can foretell future prosperity.

The presence of increasing returns to scale implies further competitiveness and

productivity in regions with initial advantages, and this in turn leads to faster output growth and persistent regional disparities. The central and western regions cannot benefit much from advanced technology spillovers, due to their lack of capital and of skilled labour. Consequently, regional inequalities are moving within a vicious cycle. Empirical evidence shows that spatial effects have been much smaller over the last decade. In other words, it is difficult now for a region to rely on the growth of neighbouring regions for its development. As a result, the effects of the cumulative process and lower spatial dependence are likely to be the main reason of the status quo in regional disparities. As Stiglitz argued, “trickle-down economics was never much more than just a belief, an article of faith.” (Stiglitz, 2003, p. 78) The Chinese government needs to step in to provide favourable policies to encourage manufacturing industries in inner lands while orienting coastal regions to high-tech industry and service trades. This complementary relationship would build connections and even reinforce industrial ties between rich and poor regions, thus favouring technology diffusion and the division of labour (in a Smithian sense).

Finally, the limits of our empirical approach should be made clear. First, the endogeneity or simultaneity problem is not fully resolved in our paper, partly because of unavailable data and partly because the bias in the regional case may be weak, but this problem might still reduce the validity of our estimates. Second, some respecifications of Kaldor’s laws might not be entirely convincing. For example, in the second relationship of Kaldor’s first law, the choice to use the excess of the manufacturing growth rate over the non-manufacturing growth rate ( $m-nm$ ) may not

avoid spurious correlation completely since this difference is a component of GDP as well, although the share in GDP is much smaller than that of manufacturing output. A similar problem also exists in the third respecification of Kaldor's first law. However, these problems also have occurred in the previous literature on Kaldor's laws, so we can only hope that a better solution will be found in the future.

## Chapter 3: A profit-led or wage-led economy? The effect of functional income distribution on aggregate demand in the case of China.

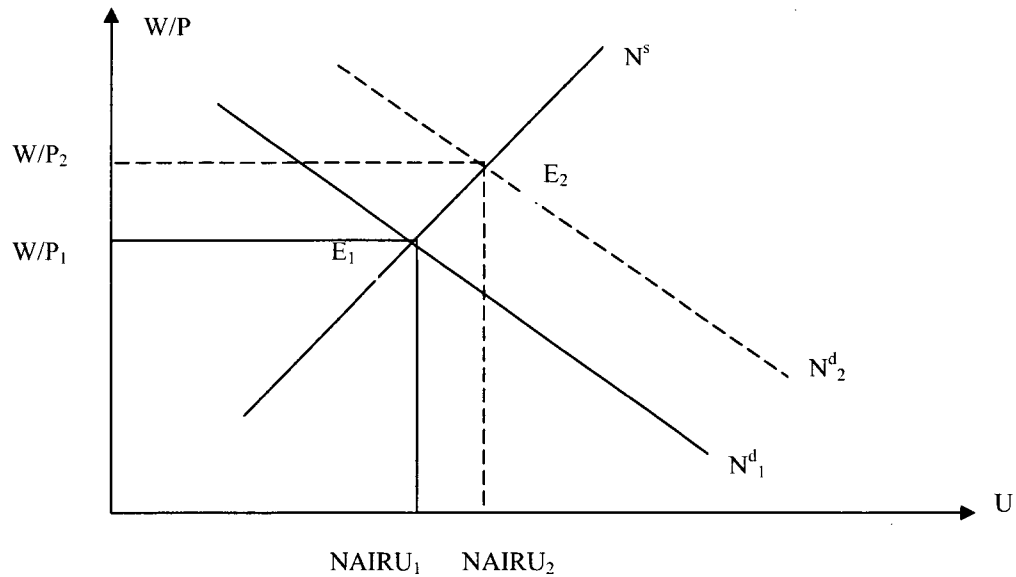
### 3.1 Introduction

The issue of the relationship between income distribution and economic growth has been substantially discussed among economists, philosophers and sociologists. After enjoying an economic boom with high real wage growth during the 1960s, the world economy turned into a wage moderation era triggered by the prevalence of neoclassical economics and the oil crisis since the early 1970s. Mainstream economists had reached a consensus that real wage restriction and labour market deregulation would be the best solutions for stagnant growth accompanied by high and persistent unemployment. In the intellectual atmosphere dominated by globalization and the free market ideas of Milton Friedman, economic policies based on high minimum wages, large unemployment benefits and strong labour unions were regarded as the causes of stagnation and high unemployment. This argument was soon adopted by major international organizations such as the IMF and OECD and the so called “employment-friendly labour costs development” prevailed in European countries (Naastepad and Storm, 2007). This idea can be illustrated graphically by Figure 3.1 (Stockhammer, 2007, p. 393), showing the demand curve ( $N^d$ ) depicting the wage setting process dominated by collective bargaining and the wage agreements between employers and employees. The labour supply curve ( $N^s$ ) represents the

cost-plus price-setting process in oligopolistic markets. The equilibrium point E indicates the non-accelerating inflation rate of unemployment (NAIRU). An increase in the power of unions moves the  $N^d$  curve to the right from  $N^d_1$  to  $N^d_2$ , giving rise to a new equilibrium position ( $E_2$ ) with a higher real wage ( $W/P_2$ ) and a higher unemployment level (NAIRU<sub>2</sub>). Neoclassical authors thus claim that high real wages are associated with high unemployment. Some New Keynesian theories incorporate asymmetric and imperfect information, such as the efficiency-wage model (Shapiro and Stiglitz, 1984), in an attempt to explain the benefits of overly high real wages. However, these theories are still constrained by the supply side because “the central idea is that if firms cannot monitor their workers’ effort perfectly, they may pay more than market-clearing wages to induce workers not to shirk.” (Romer, 2001, p. 411) In neoclassical theories, old and new, “the problem of distribution is merely on aspect of the general pricing process; it has no particular theoretical significance apart from the importance of the question per se. Nor do these theories yield a ‘macro-economic model’ of the kind that exhibits the reaction mechanism of the system through the choice of a strictly limited number of dependent and independent variables.” (Kaldor, 1989, p. 203) In addition, maybe more importantly, they pay no attention to the role played by effective demand on distribution and economic growth.

Based on the assumption of demand-driven economic growth, heterodox authors reject neoclassical claims by arguing that, despite the fact that the higher real wage compensation may harm growth and employment by raising the cost of labour, it may also generate a higher level of consumption demand and thus encourage employment

Figure 3.1: The effect of a higher real wage on the neoclassical labour market.

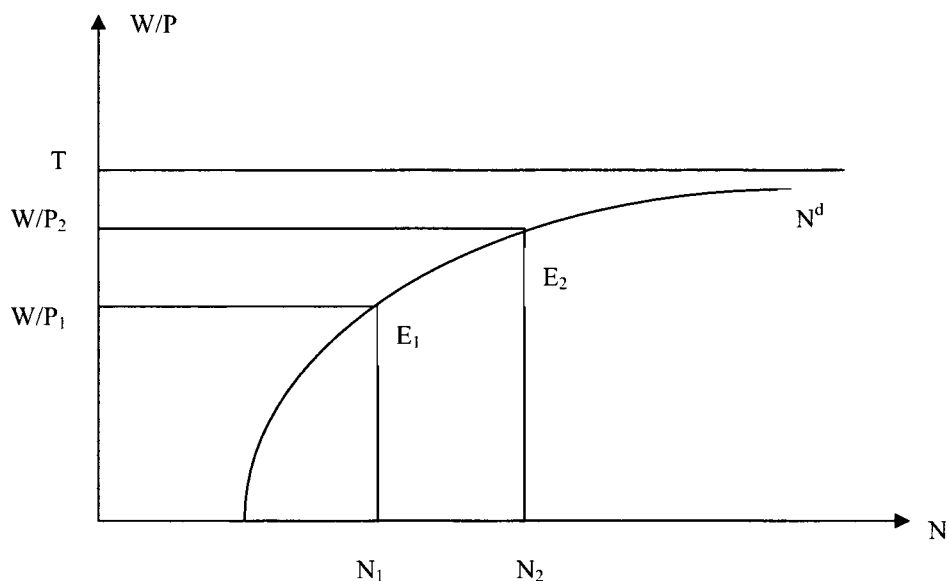


and growth if capacities are not fully utilized. Among the post-Keynesians who support the significant role of wage and effective demand for both short-run and long-run growth, there are two strands of thought concerning the effect of wage variations on aggregate demand.

The first strand is called “underconsumptionism” (Rowthorn, 1981; Dutt, 1990), emphasizing the importance of wage-induced consumption on stimulating the economy. Kalecki, one of the leading advocates of this approach, analyzes two cases under perfect competition and monopoly or imperfect competition and concludes that “there is in general no reason – in spite of widespread belief to the contrary – for the decline in production to be accompanied by an increase in real wages or vice versa.” (1991, p. 38) His basic idea can simply be illustrated by Figure 3.2 (Lavoie, 2006, p. 93).  $N^d$  is the effective labour demand curve where all wage-employment combination

points clear the good market<sup>53</sup>. In contrast with the neoclassical labour demand curve,  $N^d$  has a positive slope and converges to the level of labour productivity ( $T$ )<sup>54</sup>. A rising real wage from  $W/P_1$  to  $W/P_2$  shifts the equilibrium point  $E_1$  to the upper level  $E_2$  with higher employment. What happens is that in the Kaleckian model, firms are facing decreasing unit costs, so that their sales are constrained by demand and not by rising marginal costs.

Figure 3.2: The Kaleckian labour market.



The second post-Keynesian strand of thought, as well as Keynes himself, underlies the dominant role of investment on the aggregate demand. They argue that profits are the main element of capital accumulation that drives economic growth and a redistribution of total income from profits to wages may reduce the entrepreneurs'

<sup>53</sup> The Kaleckian effective labour demand equation in our case is  $(W/P) = T - a/N$ , where  $T$  denotes labour productivity and  $a$  represents real autonomous expenditures

<sup>54</sup> The level of real wage cannot exceed the level of labour productivity to avoid the losses of firms.

expected rate of profit and thus delay or depress their investment decisions (Robinson, 1956; Gordon, 1995). Moreover, if international trade is taken into account, a profit squeeze is more plausible since a rising wage may discourage exports by depressing the international competitiveness of domestic products. It is notable that the mechanism of this profit-led nature is quite different from neoclassical theories because it rests on the principle of effective demand instead of the theory of supply-constrained optimization.

Bhaduri and Marglin's (1990) seminal paper integrates the two strands of thought and introduces two alternative demand-driven regimes, depending on which effect prevails. In other words, the determination of whether a regime is profit-led or wage-led depends on parameter values of the income distribution effect on the consumption, investment and trade functions.

Inspired by works of many post-Keynesians such as Bhaduri and Marglin (1990, 2007), Stockhammer (2007), Stockhammer, et al. (2009) and Hein and Vogel (2008), the present paper attempts to analyze the effect of the distributional factor on consumption, investment and trade respectively in the case of China. Through empirical analysis, we wish to find out whether wages or profits play the key role for Chinese economic growth.

The outline of the paper is as follows. Section 2 provides the theoretical framework of wage-led and profit-led demand regimes in an open economy. Section 3 reviews the relevant empirical literature based on the Bhaduri-Marglin (1990) models. In section 4, based on the above theoretical framework, I will present an overview of

the Chinese macroeconomic performance from 1993 to 2007, in order to provide meaningful findings that might contribute to the conclusion. Section 5 employs panel-data techniques to estimate different partial effects of the distributional factor for each equation and summarizes all results. Section 6 will draw conclusions and some relevant policy implications.

### **3.2 The theoretical framework**

Our theoretical framework is based on the Bhaduri-Marglin analysis (1990) that is derived from Hicks's *IS*-curve and the investment-saving equilibrium on the effects of variations in income distribution on the aggregate demand in an open economy. In our benchmark model, we assume that aggregate demand is the sum of consumption (C), investment (I) and net exports (NX) specified as equation (1)

$$AD = C + I + NX \tag{1}$$

In a closed economy, redistributing income from wages to profits can lead to two possible outcomes: on the one hand, it stimulates higher investment expenditure through a higher profit share or profit rate, while on the other hand it depresses workers' consumption expenditures through a reduction in their purchasing power. The outcome of a profit-led or wage-led economy can thus be associated with the relationship between the profit share and different sources of demand. In the context of an open economy, indicators of international competitiveness such as the real

exchange rate and domestic prices can also be related to the profit share as well as other exogenous factors such as domestic and foreign economic activities. A theoretical analysis on consumption, investment and export demand will be conducted respectively in the following sections.

### *Consumption*

In light of standard accounting conventions, aggregate demand or GDP can be calculated either by a consumption-based method as shown in equation (1) or by an income-based method as follows:

$$Y = W + R \tag{2}$$

where  $W$  is total wage compensation and  $R$  is the gross operating surplus. In other words, they represent two sources of income — wage income for workers and profit income for entrepreneurs — which are used to consume. The consumption equation can be written as

$$C = (1-s_w)W + (1-s_r)R \tag{3}$$

where  $s_w$  and  $s_r$  are the propensities to save out of wages and profits respectively, i.e.,  $(1-s_w)$  and  $(1-s_r)$  represent the propensities to consume out of wages and profits.

Substituting equation (2) into equation (3), we obtain

$$C = [1 - s_w + (s_w - s_r)h]Y \quad \rightarrow \quad C = C(h, Y) \quad 0 \leq s_w \leq s_r \leq 1 \quad (4)$$

where  $h$  denotes the profit share in total income ( $h = R/Y$ ). The saving propensity out of profits is usually assumed to be larger than that out of wages because profits comprise of the retained earnings of enterprises. Thus, consumption demand is negatively associated with the profit share or total profits and positively associated with total output. Moreover, the impact of the profit share on consumption depends simply on the difference between the propensities to save out of wages and out of profits.

### *Investment*

Our analysis focuses on the equilibrium position in the goods market where there is a linear system equality between investment and saving with an exogenous change in a distributional factor.

$$I = S = s_w W + s_r R \quad (5)$$

Equation (5) indicates that total saving consists of wage-earners' saving and entrepreneurs' saving. Substituting equation (2) into equation (5), we obtain equations (6) and (7)

$$I = s_w Y + (s_r - s_w)R \quad (6)$$

$$I = [s_w + (s_r - s_w)h]Y \quad \rightarrow \quad I = I(h, Y) \quad (7)$$

Given the assumption of  $s_r \geq s_w$ , higher profits or profit share and larger effective demand or total output will induce a higher level of investment. In the short period when capacity is not fully utilized, entrepreneurs' investment decisions are mainly limited by the expected profit rate and effective demand or the rate of capacity utilization. In the long period, capital accumulation is simply the result of a succession of short-period investment decisions (Robinson, 1956). Assuming away full capacity utilization in the long period, Kalecki (1991) also argues that entrepreneurs' investment decisions are determined by expected future sales and internal finance<sup>55</sup>. There is another advantage for entrepreneurs to use internal funds, as it reduces the risk involved with using and asking for outside funds to finance new investments and "ensure a healthy financial position" (Lavoie, 2006, p. 38). In order to incorporate the expected profit rate into the investment demand function, we formulate the average profit rate as:

$$r = R/K = (R/Y)*(Y/K) = h*(Y/K) \quad (8)$$

where  $K$  is the capital stock and  $Y/K$  is the output capital ratio in the short-run. Thus,

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<sup>55</sup> In the works of Robinson (1956) and Kalecki (1991), they both argue that there are usually other constraints on investment decisions such as financial or monetary factors. We will regard these factors as exogenous control variables in empirical tests for investment functions.

we still regard the profit share ( $h$ ) as an element of the investment demand function through its effect on the profit rate<sup>56</sup>.

### *Trade*

In the case of an open economy, net export demand is determined by the international competitiveness of domestic products as well as foreign and domestic economic activities. High foreign income as the sign of large external demand leads to high exports whereas high domestic income boosts domestic demand and causes imports to rise. Domestic prices, as an indicator of international competitiveness, are related to unit labour cost, themselves linked to the distributional factor. For the sake of analysis, we assume an oligopolistic market with constant labour productivity so that a mark-up over unit direct cost pricing rule sets in (Hein and Vogel, 2008).

$$p = (1+m)(w/t + u\epsilon p^f) \quad (9)$$

where  $p$  represents domestic prices set by firms.  $m$  is the mark-up that usually reflects the market power or the degree of competition in goods market and the bargaining power between employers and employees in labour market. The unit cost consists of the unit labour cost and unit imported material cost.  $t$  denotes the constant labour productivity and  $w/t$  is thus the unit labour cost.  $u$  is the unit imported raw material input,  $\epsilon$  is the nominal exchange rate and  $p^f$  represents prices of foreign products, so

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<sup>56</sup> In line with Kaldor's stylized fact that the ratio of physical capital to output is nearly constant over time, our theoretical model will not take into account this factor.

the unit imported input in domestic currency is equal to  $\mu \varepsilon p^f$ .

We define  $\theta$  as the ratio of imported material cost to labour cost, and then we have

$$\theta = \frac{u \varepsilon p^f}{\frac{w}{t}} \quad (10)$$

Based on equation (9), the relationship between the profit share and the profit margin can be written as follows:

$$h = \frac{R}{W + R} = \frac{1}{1 + \frac{1}{m(1 + \theta)}} \quad (11)$$

Substituting equations (11) and (10) into equation (9), we get

$$p = \frac{w}{t} * \frac{1}{1 - h} + u \varepsilon p^f \quad (12)$$

Given the constant labour productivity ( $t$ ), international competitiveness can be determined by three domestic factors: the nominal wage, the profit share and the nominal exchange rate<sup>57</sup>. Irrespective of the distributional factors, lowering the nominal exchange rate is a proper policy for a country to pursue improvement in its international competitiveness. In fact, by assuming the nominal exchange rate is fixed

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<sup>57</sup> Here, nominal exchange rate = domestic currency / foreign currency

or out of control, the analysis of the effect of the profit share on international competitiveness will become more complicated and we may discuss it in different scenarios.

**Scenario 1:** There is a positive relationship between the profit share and domestic prices, i.e., an inverse relationship between the profit share and international competitiveness if the nominal wage rate remains constant. The rise in the profit share in this case is caused by the increase in the markup or profit margin that might arise from stronger monopoly power or a larger market share. As a result, a rising markup leads to higher domestic prices and thus the loss of international competitiveness.

**Scenario 2:** If an increase in the profit share is caused by a wage reduction as usually seen in distribution theory, the result might be reversed because the negative effect of a falling nominal wage rate cancels out or dominates the positive effect of the profit share on domestic prices. Consequently, falling wages (rising profit share) result in falling domestic prices and higher international competitiveness.

Thus, the net effect of the profit share on the international trade is ambiguous and has to be determined empirically. Most authors and empirical studies have confirmed the reality of the second scenario (Kalecki, 1991; Bhaduri and Marglin, 1990; Stockhammer et al., 2009). The wage level is a crucial factor to impact net exports through the effect of unit labour costs. Regarding the analysis of the effect of the profit share and economic activities on net exports, the general function is

$$NX \rightarrow NX(h, Y) \tag{13}$$

We have so far analyzed and constructed theoretical models for all components of aggregate demand respectively, as both the profit share and total output enter jointly as arguments in all theoretical works. Integrating three sectors together and combining equations (4), (7) and (13), we obtain an extension of the equation (1)

$$AD = C(h, Y, ) + I(h, Y, z_i) + NX(h, Y, z_{nx})^{58} \quad (14)$$

where  $z_i$  represent some other control variables for investment function such as real rate of interest and  $z_{nx}$  denotes other control variables for net export function such as foreign income. Since our focus of analysis is on the equilibrium position of the goods market where  $AD = Y$ , we find the derivative of  $Y$  with respect to  $h$  as follows

$$\frac{dY}{dh} = \frac{A}{1-B}, \quad A = \frac{\partial C}{\partial h} + \frac{\partial I}{\partial h} + \frac{\partial NX}{\partial h}, \quad B = \frac{\partial C}{\partial Y} + \frac{\partial I}{\partial Y} + \frac{\partial NX}{\partial Y} \quad (15)$$

We assume the denominator on the right hand side of equation (15) is positive to keep the system stability. Then, the effect of a change in income distribution on aggregate demand is positive (negative) when term  $A$  is positive (negative), i.e. whether the response of one component is stronger (weaker) than that of the rest of the components with respect to variations in the profit share. Moreover, it would be easier

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<sup>58</sup> Stockhammer et al., (2009) used a similar aggregate demand function and derivative for the Euro area.

for us to analyze the effects if both sides of equation (15) are expressed in ratio forms (as a percentage share of GDP). In other words, the effects of a change in the profit share on the growth of GDP consist of its contributions of consumption, investment and net export. We divide both sides by Y:

$$\frac{\partial Y}{\partial h} = \frac{\partial C}{\partial h} + \frac{\partial I}{\partial h} + \frac{\partial NX}{\partial h} \quad (16)$$

Thus, the sum of these partial effects on the right hand side explains how much GDP (in %) is varied by a 1% change in the profit share<sup>59</sup>. The expected signs are as follows

$$\frac{\partial C}{\partial h} < 0, \quad \frac{\partial I}{\partial h} > 0, \quad \frac{\partial NX}{\partial h} = ? \Rightarrow \frac{\partial Y}{\partial h} = ?$$

The sign of the net effect is determined by empirical estimations. The positive effect ( $\partial Y/Y/\partial h > 0$ ) indicates a profit-led demand regime and the negative effect ( $\partial Y/Y/\partial h < 0$ ) shows that the economy is wage-led.

### 3.3 Review of relevant empirical literatures

The first related work is from the post Keynesian economist Kalecki who was also a

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<sup>59</sup> Hein and Vogel (2008) used a similar method to conduct an empirical analysis of OECD countries.

well-known econometrician in his time. He statistically tested the relationship between money wage rates and industrial production in Poland in the period 1928-37 and concluded that a change in production “bears no definite relationship” to changes in money wages (Kalecki, 1991, p. 49). This analysis, however, is a rough approximation based on short time review and is lacking precise econometric techniques.

Bhaduri and Marglin (1990) have provided a more complicated and synthetic theoretical foundation for the two economic regimes and from then on, a number of empirical observations based on the extension of the Bhaduri-Marglin model have appeared in economic journals. Bowles and Boyer (1995) have attempted to apply conventional OLS estimates on separate single equations for consumption, investment and net export for five OECD countries between 1961 and 1987: the USA, the UK, France, Germany and Japan. They have first investigated the domestic sectors and found that growth in all five countries is wage-led. However, when the international trade sector is taken into account, France, Germany and Japan switched to become profit-led while the USA and the UK remained wage-led.

Gordon (1995) has employed both a single equation approach and a VAR approach using US data over the period 1955 to 1988, providing strong evidence that the US economy is profit-led. Stockhammer and Onaran (2004) have employed a structural VAR approach and incorporated labour productivity growth into the framework for the UK, the USA and France during the period 1972-97, attempting to capture the internal interactions between different variables. They have found that the

improvement of technical progress leads to larger profits but there is no significant evidence that the profit share might affect aggregate demand in these countries, whether in a closed or open economy.

Naastepad (2006) has applied OLS estimations for single equations to examine the demand regime for the Netherlands between 1960 and 2000. She has used saving instead of consumption and concluded that the economy of the Netherlands is wage-led in a closed economy. However, the evidence became weak in an open economy. Naastepad and Storm (2007) investigated the case of eight OECD countries: the USA, the UK, France, Germany, Italy, the Netherlands and Japan, from 1960 to 2000, using OLS estimations. The model they have employed is very similar to the one adopted in the present paper. They have found that domestic demand regimes of all countries except the USA are wage-led and the incorporation of international trade switches Japan to a profit-led economy.

Ederer and Stockhammer (2007) have estimated consumption, investment and net export equations separately for France from 1960 to 2004 and suggested that the French demand regime is wage-led domestically but becomes profit-led in an open economy. Compared with our estimations, they use real unit labour cost (RULC) instead of the wage share as an independent variable to explain the international competitiveness and then convert the estimated effects into the effects of the wage share (or the profit share). Stockhammer, Onaran and Ederer (2009) have employed a similar approach to test for the whole Euro area during the period 1962-2005 and concluded that the demand regime of the whole Euro area is wage-led.

Hein and Vogel (2008) have conducted similar estimations for the USA, the UK, Austria, France, Germany and the Netherlands from 1960 until 2005. According to their findings, the distributional factor has no significant effect on investment for Austria, Germany, the UK and the USA and it cannot explain the changes in net exports for France, Germany, the UK and the USA either. Thus, the effects of the profit share on the aggregate demand only depend on the effects on consumption in three of the six countries (the USA, the UK and Germany). They, of course, exhibit a wage-led nature. French economy is also wage-led due to the effects on consumption that outweigh those on investment. However, the significance of the effects on net export turns Austria and the Netherlands into profit-led regimes.

Hein and Vogel (2009) have applied both a single equation approach to estimate the effects of distribution and a simulation approach to capture interactions for France and Germany from 1960 to 2005. The former estimation suggests that France is slightly wage-led mainly because there is no significant effect of the profit share on net exports, whereas the growth nature in Germany is unclear since it switches from wage-led to profit-led when taking into account the “weakly significant” positive effect on investment. The latter approach confirms the wage-led nature in France and suggests that Germany is wage-led as well in the long-run.

All of the empirical literatures we have reviewed so far are attentive to developed countries, while empirical evidence for developing countries remains limited. Onaran and Stockhammer (2005) have employed a structural VAR model for Turkey and South Korea from 1965 to 1997. They investigated the two different export-led

growth strategies and find that the effects of the profit share on domestic demand is weak but demand regimes turned out to be wage-led for both Turkey, where a high profit share is not found to stimulate investment, and South Korea. Some other studies, nevertheless, claim that “economies would switch to profit-led demand regimes with export and import shares between 35% and 45% of GDP” and this accounts for the fact that the Euro area is wage-led as a whole but profit-led individually since they “have substantially higher exposure to international trade” (Stockhammer, 2007, p. 396).

Certainly, empirical evidence may hardly be consistent between developed and developing countries. Apart from the different economic characteristics associated with different countries, such inconsistency is mainly caused by differences in estimations, time periods covered and data sources used. As a typical example of a large open developing economy, the Chinese demand regime cannot be determined a priori. Notably, the history of macroeconomic data collection on distributional variables in China is very short, merely starting from 1993, which is certainly not enough for time series tests. Thus, we rely on panel estimations using Chinese regional data, as it seems to be the only viable approach to study Chinese economic development from an empirical perspective. Similar to most empirical studies we have previously presented, we employ respective single equations for each of the consumption, investment and net export functions. Moreover, another interesting contribution is that this paper is the first to estimate the Bhaduri-Marglin model by means of a panel of regional data.

### **3.4 Chinese macroeconomic performance from 1993 to 2007**

The policy of wage moderation in European countries has been criticized by many heterodox authors recently. They provide stylized facts showing that “golden age prosperity” for OECD countries after World War II is associated with real wage growth while stagnation and lower unemployment since the middle of the 1970s is characterized by a profit squeeze (Naastepad and Storm, 2007; Stockhammer, 2007). This situation revives discussions on the relationship between income distribution and economic growth.

Wage moderation also appears to be popular in China. In a recent conference, Xie, the commissioner of National Bureau of Statistics of China has argued that rising wages, particularly for middle and low income earners would both jeopardize the profits of firms and result in inflation<sup>60</sup>. The new labour law that aims to protect workers and improve the social security system has been regarded by many Chinese authors as the main cause of firm bankruptcies and high unemployment. They claim that the profit is the key to economic growth.

Before the economic transformation was undertaken three decades ago, China, as a purely socialist country, was characterized by the low level of consumption, savings, investment and employment. Chinese economic growth was supply-constrained because the supply of technology, raw materials, skill labour, capital and information was administered or deficient. This was so despite the apparent communist motto that

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<sup>60</sup> In reference to Xie’s speech in the Academic Summit of China’s Development and Reform in 2008: <http://news.jxgdw.com/cj/777398.html> (Chinese).

described a demand-led economy: “From each according to his ability and [supply] to each according to his means [demand]”. Consumption was depressed by low household income and distribution restrictions. All investment projects were planned by central government and there was no private investment at all. Demand was greatly suppressed<sup>61</sup>.

Over the last two decades, it has been widely accepted that the unprecedented Chinese economic expansion is driven by investment and exports. According to many studies of Chinese economic development, China’s remarkable growth is characterized by low consumption and high investment (Aziz and Li, 2007). On the one hand, Chinese households consume less and save more so that they can mitigate any uncertainty over future disposable income, healthcare and education costs. Statistics show that saving constitutes 25 to 30% of their income which is much larger than the saving rates in developed countries. On the other hand, low-wage production not only generates more profits for entrepreneurs but also stimulates exports through price competitiveness. In fact, China’s investment projects are mainly driven by enterprise profits (retained earnings), foreign investment and government expenditures due both to the entrepreneurs’ prudential attitude towards debt and to the inefficient and immature capital market. Thus, higher profits give entrepreneurs stronger incentives to invest. In sum, investment dominates Chinese economic growth.

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<sup>61</sup> To better control the market, in addition to a number of means we showed, a special bill called “Ration Coupon” for all goods such as food and cloth was also incorporated into the monetary circuit. People were not allowed to purchase goods without the corresponding ration coupons even if they had money. The adoption of ration coupons undermined Chinese domestic demand further.

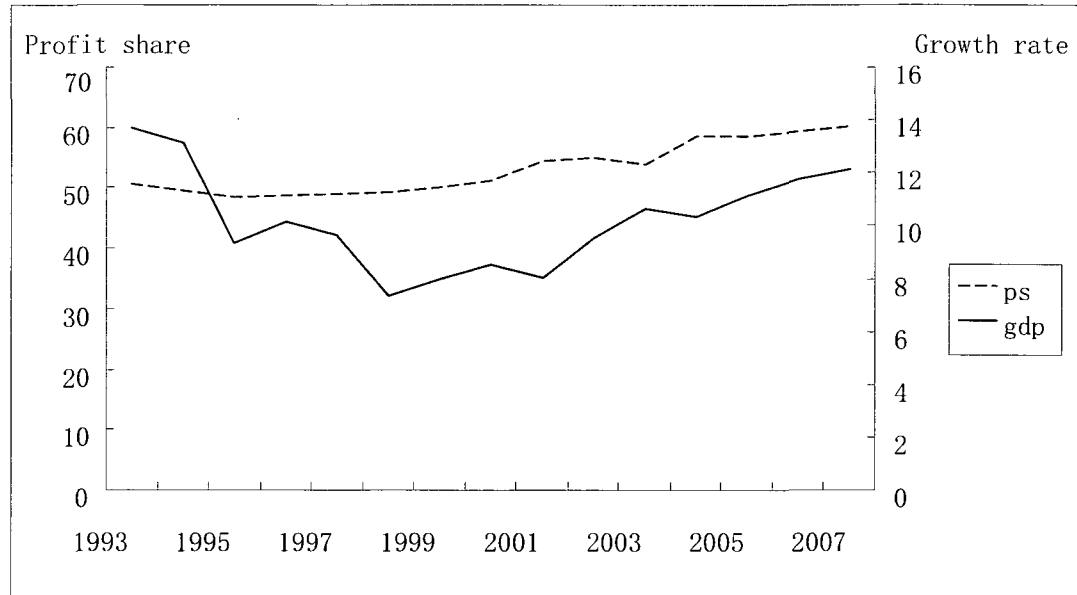
At a deeper level, high export growth is an inevitable consequence of low consumption growth: personal consumption cannot match the rapid rise in investment and entrepreneurs have to rely on external demand to utilize idle capacities to realize profits. Until they obtain a monopoly power with large-scale production, wage reduction is the best way to stimulate exports, which in turn depresses household income and consumption and leads to a vicious circle.

Figure 3.3 describes the development of the profit share and growth rate of real GDP from 1993 to 2007 for China, illustrating that there is an apparently positive correlation between profits and growth. In the middle of the 1990s, output growth declined, reflecting a normal slowdown after an era of prosperity in the early 1990s<sup>62</sup>. Nevertheless, the main reason for this decline may be found in the former premier Zhu's policy of "soft-landing" that attempted to cool down the overheating economy by exposing non-performing assets in financial sectors. The regulation of financial markets and tighter restrictions on credit depressed the capital accumulation and investments of firms. We find a slight reduction in the profit share associated with a decline in output growth during this period. Starting from the late 1990s, strong foreign demand, a recovery from the Asian financial crisis and the healthy balance sheets of financial institutions have been conducive to profits and investments, which were, in turn, followed by sustained economic growth.

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<sup>62</sup> The economic take-off in the early 1990s in China arose from ex-leader Deng Xiaoping's south tour. He confirmed the success of Chinese market economy and claimed the necessity of deepening the economic reform, which boosted foreign direct investment and GDP growth.

Figure 3.3: Profit share and rate of real output growth in China

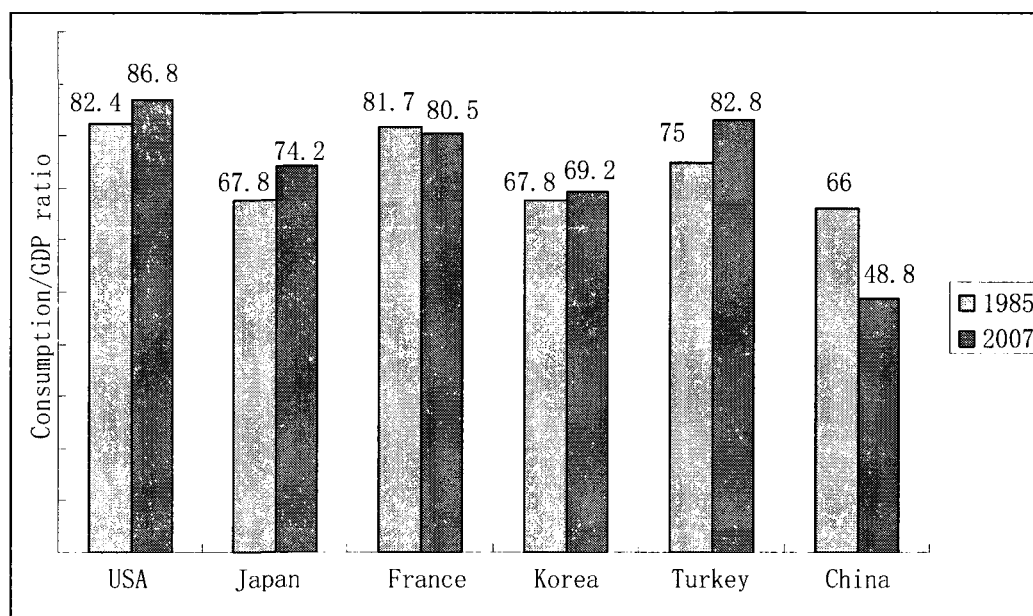


Source: China Statistical Yearbooks, 1993-2007

Figure 3.4 indicates the comparison between domestic consumption and GDP ratios of six countries between 1985 and 2007. By observing 3 developed countries and 3 developing countries including China, we find that most countries have experienced a rising share of consumption in GDP over the last two decades while the ratio of France remained relatively stable. In contrast, the share of consumption devoted to GDP fell by almost 20% in China. This graph clearly shows that the Chinese economic take-off cannot be attributed to consumption. While it is inappropriate to neglect the significant growth of domestic consumption, investment has grown faster and the expansion of the share of investment has far outweighed that of consumption. The switch from consumption to investment as the leading contributor to GDP can be explained by China's export-oriented strategies aimed at enlarging foreign markets by sacrificing domestic demand through wage moderation.

In addition to the constraints put on income and social insurance programs, consumption may also be restrained by Chinese cultural habits and customs of thrift.

Figure 3.4: Consumption/GDP ratios for different countries in 1985 and 2007



Source: OECD and China Statistical Yearbooks (1985 and 2007)

Table 3.1 presents key indicators of macroeconomic performance in the coastal area and in the inland area in 1993 and 2007. According to statistics, the growth of real GDP in both areas has accelerated while the wage share declines. Consumption growth in the inland area is smaller than that in the coastal area, confirming the strong consumption propensities in the rich area. In both areas, consumption growth lags GDP growth. Investment growth is higher than GDP growth in both areas, meaning that investment plays a more important role in affecting the output growth. An interesting finding is that investment growth (as well as GDP growth) in the inland area is higher than that in the coastal area. This could be due to two reasons: first, the

central government is concerned over growing regional inequality and some policies have been provided to help the inland area. For example, the ‘West Development Policy’ launched by the central government has brought a vast amount of public investment expenditures and has promoted economic growth in the inland area. Second, recently, the investment environment in the coastal area has deteriorated because of rising labour and raw material costs, which forced capital and investment to move to the inland area where labour is cheaper and where there are more natural resources. While the growth of net exports<sup>63</sup> keeps strong in the coastal area, growth of net import is substantially higher in the inland area. This could be attributable both to the rising household income and to the lack of manufacturing industries in the inland area. The wage share has fallen by a large amount (by 12%) in the coastal area in order to maintain price competitiveness and high growth of exports. As a result, sustained high growth in both the inland area and the coastal area is associated with rising profits (a falling wage share).

Although falling wage shares are also observed in other developed countries, household income does not necessarily decline because of the rising dividend, interest income and investment income (e.g., housing investment). Households in China, however, receive little from investment and government transfers. Wages constitutes a large proportion of their income and a decline in wages would immediately reduce household consumption.

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<sup>63</sup> The term “net outflow of goods and services” is provided by the China Statistical Yearbook, but we use the term “net regional exports” instead in the rest of the paper. Reasons are given in the next section.

Nevertheless, the global recession that took place in 2008 has destroyed the rosy image of long-lasting profit-led investment and growth. In fact, prior to 2008, investment growth in the coastal area had slowed down as a result of rising material costs and a falling profit rate. The inflation rate of 7% reached a record height in 2008 and raw material costs rose by more than 10%. Moreover, the new labour contract law that is intended to address worker's rights by enhancing the compensation standard has imposed regulatory burdens on firms. The contraction of global demand has worsened the living environment of firms. As a consequence of these harsh conditions, profit rates of the low value-added manufacturing firms in the coastal area have declined to the level of zero (even negative) and the overall unemployment rate has risen sharply to around 20% according to certain statistical agencies<sup>64</sup>.

Table 3.1: Macroeconomic indicators (growth rates) for coastal area (eastern regions) and inland area (central and western regions) in 1993 and 2007

	Inland Area		Coastal Area	
	1993	2007	1993	2007
Real GDP (%)	3.73	15.36	7.52	10.89
Real consumption (%)	3.51	10.52	8.70	11.97
Real investment (%)	0.62	38.53	9.13	15.59
Real net outflow of goods and services (%)	-8.25	-26.16	12.05	17.98
Wage share (%)	46	39	54	42

<sup>64</sup> Many Chinese economists argued that official statistics of the unemployment rate is substantially underestimated. Taking into account the surplus labour in the rural area, the actual unemployment rate in China is probably around 15% ~ 20%.

### 3.5 Empirical tests

#### Data

Regional Data for 29 provinces or municipalities<sup>65</sup> in China are obtained from the PRC Statistical Bureau covering the years of 1993 to 2007. There are two advantages of using panel data in the present paper. First, panel data takes into account the inter-regional heterogeneity and avoids the possible variations both over time and across regions. This issue is particularly important for us in studying the unbalanced economic development in the sectors of consumption, investment and trade between affluent and poor regions since all these sectors always exhibit significant regional heterogeneity. The other advantage is that given the fact that time series data are not long enough, panel data provides more reliable results and higher degrees of freedom.

Definitions of the variables used in the models are listed in Table 3.2<sup>66</sup>. All regional level data are deflated to constant prices<sup>67</sup> by price deflators of regional final consumption that is obtained from the PRC Statistical Bureau as well. Gross operating surplus (gross profits) is employed, instead of net operating surplus<sup>68</sup>, to ensure that the summation of wage and profit income equals total output. Foreign income is composed of the weighted real GDP of five of China's largest trading partners<sup>69</sup>: USA,

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<sup>65</sup> The introduction of Chinese 29 provinces or municipalities has been described in my second essay.

<sup>66</sup> All level variables are converted into logarithms in the following tests.

<sup>67</sup> 1993=100

<sup>68</sup> Gross operating surplus = Net taxes on production + Depreciation of fixed assets + Net operating surplus

<sup>69</sup> The bilateral trade volume between China and these partners is larger than 150 billion US dollars in 2007. Weights are calculated as the shares of total trade volume of the five partners and the data of real GDP (2000=100) of these partners are obtained from the International Monetary Fund, World Economic Outlook Database, October 2008. Also, values of foreign real GDP are converted into Chinese Yuan at current exchange rates.

EU<sup>70</sup>, Japan, Hong Kong and Korea. According to the China Statistical Yearbook, net outflow of goods and services is defined as the difference between the outflow of goods and services sold or gratuitously transferred from resident units to non-residents units and the inflow of goods and services sold or gratuitously transferred from non-resident units to resident units. Thus, each region's net outflow of goods and services consists of both the amount of trading with foreign countries and the amount of trading with other regions in China. This is roughly net regional exports.

Table 3.2: Definitions of the variables

Variable	
$C_i$	Regional real private final consumption expenditure
$W_i$	Regional real compensation of employees
$R_i$	Regional real gross operating surplus (gross profits)
$I_i$	Regional real gross fixed capital formation
$Y_i$	Regional real gross regional product
$Y^f$	Real trade-weighted GDP of five main trading partners
$Y^d$	China's real GDP
$NX_i$	Regional real net regional exports (net outflow of goods and services)
$h_i$	Regional adjusted profit share as percentage of regional product at current market prices, calculated as 1 minus adjusted regional wage share
$r_i$	Regional real rate of interest

<sup>70</sup> The main trading partners of European countries are: France, Germany, Italy, Dutch, Spain and United Kingdom

### **Econometric methodologies and empirical results**

The unit root test proposed by Levin, Lin et al. (2002) is used to test the stationarity of the panel data. The presence of unit roots indicates that the non-stationary data may bias the OLS estimation due to the possible correlation between disturbances of the current period and those of previous periods. The conventional method to deal with the non-stationary data is to use the first difference instead of the absolute level of each variable to remove the unit root. Levin, Lin et al (2002) propose a powerful panel unit root especially for small samples based on a pooled Dickey-Fuller regression, allowing for both individual effects and period effects. Moreover, another unit root test in presence of cross section dependence that is developed by Pesaran (2007) is conducted to test for the robustness of results. This test controls for heterogeneity in panels and deals better with the issue of larger N than T. Table 3.3 presents the results of both unit root tests. The null hypothesis of non-stationarity for all variables are rejected at the 1% level of significance indicating all variables are not suffering from unit root problems. However, the absence of unit roots might result from the short time span. As suggested by Baltagi (2005), a sample size with more than 20 periods would be better to fit this test. Indeed, we are still confident in the validity of our results since unit root problems are always less significant in a small panel data set especially one incorporating the logarithmic variables in the model (Wooldridge, 2002).

Table 3.3: Panel Unit Root Tests

Variable	P-value estimated by Levin-Lin panel unit root test <sup>71</sup>	P-value estimated by Perasan's simple panel unit root test in presence of cross section dependence <sup>72</sup>
lnC	0.0000	0.021
lnW	0.0000	0.039
lnR	0.0000	0.048
lnI	0.0001	0.013
lnY	0.0000	0.003
lnY <sup>f</sup>	0.0000	0.0000
lnY <sup>d</sup>	0.0000	0.0000
NX/Y	0.0000	0.049
H	0.0000	0.003

A one-way error component regression model that usually appeared in most panel data studies is utilized in this paper. The model can be described by the following equations:

$$y_{it} = \alpha + \delta y_{i,t-1} + x'_{it} \beta + u_{it} \quad i = 1, \dots, N ; t = 1, \dots, N \quad (3.5.1)$$

$$u_{it} = \mu_i + v_{it} \quad \text{where } \mu_i \sim \text{IID}(0, \sigma_\mu^2) \text{ and } v_{it} \sim \text{IID}(0, \sigma_v^2) \quad (3.5.2)$$

$\mu_i$  is time-invariant and it captures the unobserved state-specific heterogeneity that can not be denoted by a common intercept. A fixed effect model is used to control the unobserved effects that differ between individuals and are constant over time by assuming  $\mu_i$  to be fixed. A random effect model takes into account the mixed effects across states and over time by assuming  $\mu_i$  to be random. The Hausman test is a

<sup>71</sup> The null hypothesis is the series has unit root and the specified lag length is 1. Constant and trend terms are included in the estimation.

<sup>72</sup> The null hypothesis is the series has unit root and the specified lag length is 0. Constant and trend terms are included in the estimation.

generally accepted method to make a choice between fixed and random estimators. While the fixed effect model is the main technique of panel data analysis, the random effect model is preferred to avoid the loss of degrees of freedom when there are too many variables in the model. (Baltagi, 2005).

Serial correlation is also a potential problem in most panel data applications which can be shown in equation (3.5.3):

$$v_{it} = \rho v_{i,t-1} + \varepsilon_{i,t} \quad \text{where } |\rho| < 1 \text{ and } \varepsilon_{it} \sim \text{IID}(0, \sigma^2_\varepsilon) \quad (3.5.3)$$

This equation shows that the disturbances follow an AR(1) process. Empirical studies reveal that some macroeconomic indicators such as consumption and investment always suffer from serial correlation, for the effect of an unobserved shock at one period on the model usually lasts for at least one period. Ignorance of this problem upon its occurrence would lead to consistent but inefficient OLS estimators (Baltagi, 2005). Baltagi and Wu (1999) have provided an estimation of a panel data model with AR(1) disturbances by constructing a new variance-covariance matrix to transform the AR(1) disturbances into serially uncorrelated errors. Moreover, this estimation also accommodates fixed and random effect estimations. In the same paper, they have also proposed a LBI test for the hypothesis of no serial correlation against the alternative of positive or negative serial correlation. Moreover, Bhargava et al. (1982) have suggested a modified Durbin Watson test for the presence of serial correlation in the fixed effect model.

Another issue is the dynamic relationship with a lagged dependent variable among the regressors. According to the equation (3.5.1),  $y_{it}$  is a function of  $u_i$ , then  $y_{i,t-1}$  is also a function of  $u_i$  since  $u_i$  is constant over time. This would lead to the inconsistent OLS estimator because the regressor  $y_{it}$  is correlated with the error term even if there is no serial correlation in the error term ( $v_{it}$ ) (Baltagi, 2005). We utilize the GMM technique suggested by Arrelano and Bond (1991) to overcome the possible bias arising from the presence of the lagged dependent variable. This method estimates the dynamic equation by taking the first differences of key independent variables, i.e. by getting rid of  $\mu_i$  in equation (3.5.2) and other individual effects in equation (3.5.1). This estimation has two advantages: first, first-differenced variables would avoid the possible occurrence of unit root problems; second, there is no requirement of any assumption or distribution of  $v_i$ <sup>73</sup> and  $u_i$  (Baltagi, 2005). Nonetheless, it is noticeable that the reliability of the dynamic estimation depends on certain conditions that need to be clarified before proceeding with the empirical results: first,  $v_{it}$  is required not to be serial correlated to ensure the consistency of the GMM estimator. Arellano and Bond (1991) propose such a test for the null hypothesis of no second-order serial correlation for the error terms of the first-differenced equation; second, the statistics of the Sargan test of over-identifying restrictions can not reject the null hypothesis that the instruments used in the estimation are valid (Baltagi, 2005). If these two requirements are satisfied, we prefer the results of the dynamic estimation; otherwise, the results of the conventional static estimations will

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<sup>73</sup> Note however that there is some requirements on  $v_{it}$ .

be used in the analysis. In addition, robust standard errors are used to overcome the possible heteroscedasticity problem when necessary.

We will conduct separate estimations for the whole nation (29 regions) and for the coastal area (12 regions) for the sake of comparison. Given the fact that the coastal area is the leading area of the Chinese economy, which is more affluent than the inland area, it is conceivable that such analysis will be helpful in revealing the structure and nature of the Chinese economic system among different regions and between the regions and the central government.

### *Consumption*

According to the previous theoretical analysis (equation (4)), the consumption function has the general form of  $C = f(W, R)$ . Total consumption is determined by workers' wage income and entrepreneurs' profit income weighted by their consumption propensities. For the sake of estimation, all variables are converted into logarithms and the model is constructed as:

$$\ln C_{i,t} = \text{cons} + \beta_1 \ln C_{i,t-1} + \beta_2 \ln W_{i,t} + \beta_3 \ln R_{i,t}$$

It is unnecessary to employ the first-differenced variables because of the stationary data set suggested by the unit root tests. Estimates of coefficients indicate the short-run elasticities rather than partial effects of consumption with respect to the wage and profit income due to the logarithmic transformation.

Empirical results of the consumption function estimated by different estimations are indicated in Table 3.4. All estimations show the high goodness of fit due to high values of R-square statistics and estimates of key variables are highly significant at the 1% level of significance, suggesting the robustness of results. The OLS estimation that ignores the state and time effects yields low short-run consumption elasticities for wage and profit income of 0.1234 and 0.0482 respectively. However, the coefficient of lagged consumption is 0.834 that implies higher long-run elasticities of 0.7433<sup>74</sup>

Table 3.4: Empirical results for the consumption function (all regions)

	Constant	$\ln C_{i,t-1}$	$\ln W_{i,t}$	$\ln R_{i,t}$	R <sup>2</sup>
OLS	0.0012 (0.902)	0.8340 (0.000)	0.1234 (0.000)	0.0482 (0.000)	0.9955
Within	-0.0105 (0.803)	0.595 (0.0000)	0.299 (0.000)	0.105 (0.000)	0.9936
AR(1) error	0.1896 (0.000)	0.2085 (0.000)	0.4611 (0.000)	0.2448 (0.000)	0.9811
Dynamic model <sup>75</sup>	0.1690 (0.000)	0.4230 (0.000)	0.2739 (0.000)	0.2330 (0.000)	

#### Diagnostic Testing

Modified Wald test for heteroskedasticity	Hausman Test Statistic (P)	Modified Bhargava et al. Durbin-Watson Statistics	Balgati-Wu LBI statistics	Sargan Test <sup>76</sup>	Arellano-Bond test <sup>77</sup>
0	0	1.84	1.93	0.0000	Order 1 0.0078 2 0.5488

<sup>74</sup> The long-run wage income elasticity is calculated by  $\frac{\beta_{wage}}{1 - \beta_{lagged}}$  where  $\beta_{lagged}$  is the coefficient

of the lagged dependent variable and  $\beta_{wage}$  is the coefficient of wage income.

<sup>75</sup> The R<sup>2</sup> statistics of dynamic models are not provided by STATA

and 0.29 respectively. The Within estimator of the fixed effect model is chosen by the Hausman test statistic, suggesting higher short-run elasticities of 0.299 and 0.105 respectively, but similar long-run elasticities of 0.738 and 0.26. State dummies are jointly significant and the explanatory power is high with an observed F-statistic<sup>78</sup> and high value of R-square statistic. These results emphasize the importance of including state effects in the equation. The AR(1) model is used to control for the possible presence of serial correlation of error terms with AR(1). However, the modified Bhargava et al. Durbin-Watson statistic and Baltagi-Wu LBI statistic are not strong enough to reject the null hypothesis of no first-order serial correlation. With respect to the dynamic feature of this model, the first three estimations do not take into account the endogeneity of lagged consumption. The last row gives estimates of the dynamic estimation using Arellano and Bond (1991) GMM method.

The last two columns of the Diagnostic Test table provide statistics for the two requirements of using the dynamic estimation. The Sargan test rejects the null hypothesis meaning that invalid instruments might lead to weak results, although this could be due to the bad power of this test for the relatively small sample size (N=29, T=15). Thus, the Within estimators are preferred in testing for the consumption function.

As expected, the estimate of the consumption coefficient for wages is

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<sup>76</sup> The Sargan test of over-identifying restrictions is used to test for the validity of first-differenced instrument variables. The significance of this test suggests our instruments may be invalid.

<sup>77</sup> The Arellano-Bond test for zero autocorrelation in first-differenced errors indicates that it rejects the null of no first-order serial correlation, while not rejecting the null that there is no second-order serial correlation, we expect errors to be not serially correlated in a first-differenced equation.

<sup>78</sup> The F-statistic is 5278.44 with a p-value of 0

significantly larger than that for profits, which confirms the assumption that the consumption propensity out of wages is higher than that out of profits. The partial effect of a change in the profit share converted from elasticities by using average values  $C\_bar$ ,  $R\_bar$  and  $W\_bar$  over the whole period and all regions, is

$$\frac{\partial C/Y}{\partial h} = \frac{\beta_3}{1-\beta_1} \frac{C\_bar}{R\_bar} - \frac{\beta_2}{1-\beta_1} \frac{C\_bar}{W\_bar} = -0.177$$

In addition, we calculate another partial effect using levels  $C\_2007$ ,  $R\_2007$  and  $W\_2007$  of the last year 2007 over all regions. Converting elasticities into partial effects based on two different evaluations would yield two different results that produce more robustness. Another advantage of evaluating partial effects in two separate ways is that we could generally observe the changes and evolutions of household behavior along with the economic development over time because our calculations are based both on the mean of the whole sample and the levels at the end.

$$\frac{\partial C/Y}{\partial h} = \frac{\beta_3}{1-\beta_1} \frac{C\_2007}{R\_2007} - \frac{\beta_2}{1-\beta_1} \frac{C\_2007}{W\_2007} = -0.197$$

Both partial effects of an increase in the profit share on consumption expenditures are negative, which supports our theory that a higher profit share will reduce the total consumption of the economy. More specifically, a 1% rise in the profit share will reduce private consumption by 0.177% at the mean of the sample and by 0.197% at

the 2007 levels. The reason why the partial effect at the 2007 level is smaller is that people acquire stronger consuming ability when they are getting economically better off.

Empirical results for the coastal area are presented in Table 3.5. We do not include results of other estimations since the analysis is similar to that conducted previously and fixed effect estimators are preferred. After conversion, the direct partial effects of the profits share on the growth contribution of consumption are -0.34 at the mean levels and -0.37 at the 2007 levels. This suggests a stronger negative influence of profits on consumption because of higher wage income and household's unthrifty habits in rich regions. In addition, our findings are nearly identical to the results found in France (-0.35) and Germany (-0.317) (Hein and Vogel, 2008). Our results are also in line with what Stockhammer, et al. (2009) found for whole Euro area (-0.37).

Table 3.5: Empirical results for the consumption function (coastal regions)

	Constant	$\ln C_{i,t-1}$	$\ln W_{i,t}$	$\ln R_{i,t}$	$R^2$
Within	-0.1483 (0.803)	0.3610 (0.0000)	0.4869 (0.000)	0.0853 (0.000)	0.9923

### *Investment*

According to equation (7), the investment size is determined by the regional capacity utilization and regional profit income. As usually suggested by most studies, real total output is used to proxy the level of capacity utilization. In addition to one region's own capacity utilization, output in other regions also plays a significant role in

determining the investment of this region. In fact, more and more entrepreneurs in the coastal area are building factories and planning investment in the inland area in order to take advantage of lower labour costs. On the other hand, central planned public expenditure has been a large component of the regional investment all along. In this sense, the incorporation of China's real GDP ( $Y^d_t$ ) aims to proxy the two factors that might influence regional investment. The real rate of interest is included in the function as well, to control over the possible variations of investment caused by monetary factors.

$$\ln I_{i,t} = \text{cons} + \alpha_1 \ln I_{i,t-1} + \alpha_2 \ln Y_{i,t-1} + \alpha_3 \ln Y^d_t + \alpha_4 \ln R_{i,t} + \alpha_5 r_{t-1}$$

The investment equation is also estimated using the four different estimations previously mentioned. All F statistics or Wald statistics<sup>79</sup> indicate the overall significance of the model and high R-square statistics of the first three estimation indicate the high goodness of fit. The real rate of interest has the expected sign except in the AR(1) estimation, but it is insignificant in all estimations. An interesting finding is that empirical results of all estimations show that regional income has no significant effect on regional investment while China's real GDP significantly affect regional investment. This can be explained by two reasons: first, the income of central and western regions is mainly obtained from their agricultural income and remittance transfers from people who are working in coastal regions. The majority of this income is then distributed in the agriculture sector for purchases such as seeds, pesticides and fertilizers for the following year and thus only a small proportion of it is used for

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<sup>79</sup> P-values of all test for overall significance are 0

Table 3.6: Empirical results of the investment function (all regions)

	Constant	$\ln I_{i,t-1}$	$\ln Y_{i,t}$	$\ln Y_t^d$	$\ln R_{i,t}$	$r_{t-1}$	$R^2$
OLS	-0.7944 (0.002)	0.8606 (0.000)	0.0607 (0.227)	0.1946 (0.000)	0.0589 (0.203)	-0.0007 (0.771)	0.9822
Within	-0.8160 (0.001)	0.8526 (0.0000)	-0.1086 (0.500)	0.2528 (0.021)	0.1712 (0.075)	-0.0005 (0.824)	0.9809
AR(1) error	-1.126 (0.000)	0.6538 (0.000)	0.09138 (0.337)	0.2705 (0.000)	0.2102 (0.022)	0.0026 (0.352)	0.9807
Dynamic model	-0.9449 (0.001)	0.8340 (0.000)	0.0588 (0.746)	0.2471 (0.071)	0.0561 (0.621)	-0.00014 (0.933)	

Diagnostic Test Table

Modified Wald test for heteroskedasticity	Hausman Test Statistic (P)	Modified Bhargava et al. Durbin-Watson Statistics	Balgati-Wu LBI statistics	Sargan Test	Arellano-Bond test
0	0	1.0998	1.7526	0.0000	Order p-value 1 0.0298 2 0.3378

fixed investment. In other words, the focus on agricultural production results in a shortage of capital that ruptures the link between capacity utilization and investment; second, large-scale investment plans are always dominated by the central government and the investment decisions of central government rely on total GDP rather than regional output.

Nonetheless, the significance of the coefficients of the key variable profit income ( $R_{it}$ ) differs between different estimations. In the second row, results of the fixed effect model, as suggested by the Hausman statistic, improve its significance compared with the conventional OLS estimators. The short-run elasticity of investment with respect to profits becomes significant at a moderate level and is

increased from 0.0589 to 0.1712. This improvement might arise from the fact that the amount of investment or capital accumulation always exhibits regional heterogeneity and this state effect is captured by the Within estimators. Both the Baltagi-Wu LBI statistic of 1.616 and the Bhargava et al. Durbin-Watson statistic of 1.424 suggest the presence of serial correlation. The presence of serial correlation and the significance of the Sargan test invalidate the dynamic estimators. Based on the comparison of all estimations, the results provided by the AR(1) model that both captures the state effects and corrects serial correlation are therefore preferred.

As with calculations for the consumption function, the partial effect of profit income on investment can be obtained by converting the long-run elasticity of investment with respect to the profit income over the whole period either at the mean levels or at the 2007 levels.

$$\frac{\partial I / Y}{\partial h} = \frac{\alpha_3}{1 - \alpha_1} * \frac{I\_bar}{R\_bar} = 0.4348$$

$$\frac{\partial I / Y}{\partial h} = \frac{\alpha_3}{1 - \alpha_1} * \frac{I\_2007}{R\_2007} = 0.4822$$

The results show that a redistribution of 1% of regional income from wage to profit will lead to a 0.4348% and 0.4822% rise in the investment demand at the mean levels and at the 2007 levels respectively. Compared with the partial effect on consumption, the relatively larger effect on investment indicates the importance of profits in investments and the profit-led nature of the Chinese economy, even without regards to

the trade sector.

Table 3.7 provides empirical results for the coastal area based on the AR(1) estimation<sup>80</sup>. In contrast to the national results, we find that China's real GDP has no effect on investment in the coastal area. This might be explained by the following facts: first, investment in the coastal area is largely driven by foreign direct investment (FDI)<sup>81</sup>; second, central government usually provides favorable policies rather than direct capital to the coastal area; third, there are few investment projects in the coastal area that are induced by the development of the inland area. The long-run partial impacts of the profit share on the growth contribution of investment are<sup>82</sup>

$$\frac{\partial I / Y}{\partial h} = \frac{\alpha_R - \alpha_{R\_lag}}{1 - \alpha_1} * \frac{I\_bar}{R\_bar} = 0.406$$

$$\frac{\partial I / Y}{\partial h} = \frac{\alpha_R - \alpha_{R\_lag}}{1 - \alpha_1} * \frac{I\_2007}{R\_2007} = 0.322$$

Table 3.7: Empirical results for the investment function (coastal regions)

	Constant	lnI <sub>i,t-1</sub>	lnY <sub>i,t</sub>	lnY <sub>t</sub> <sup>d</sup>	lnR <sub>i,t</sub>	lnR <sub>i,t-1</sub>	r <sub>t-1</sub>	R <sup>2</sup>
AR(1)	-0.184 (0.639)	0.662 (0.000)	0.122 (0.502)	0.051 (0.543)	0.648 (0.002)	-0.475 (0.004)	0.001 (0.780)	0.9751

<sup>80</sup> Modified Bhargava, et al. Durbin-Watson statistic and Baltagi-Wu LBI statistic are 1.128 and 1.802 respectively, indicating the presence of serial correlation.

<sup>81</sup> The effect of FDI can be incorporated into our equation by the variable of gross profits (R<sub>i</sub>) that is defined to constitute profits of local and foreign invested firms.

<sup>82</sup> The lagged profit income is included because of its significance effect.

The results show that in the coastal area, a 1% rise in the profit share increases investment by 0.406% of aggregate demand at the mean levels and this number is reduced to 0.322% at the 2007 levels. The reduction in the share of investment in aggregate demand is absorbed by the rising wage-induced consumption. The effects are larger than what were found in most developed countries (Hein and Vogel, 2008, Stockhammer et al. 2009).

### *Net Exports*

As shown in the theoretical framework, one region's net exports of goods and services is negatively related to its real output and is positively related to foreign demand that is, denoted by real GDP of China's main trading partners. In our case, in addition to international trade, interregional trade is also an important component of regional trade. Moreover, the demand of central government significantly improves regional trade. We thus include Chinese real GDP in our net export function to indicate Chinese domestic demand as another source of demand for regional trade. Another key determinant of trade is price competitiveness, as measured by profits or the profit share, based on equation (12). We use the net export ratio instead of the logarithmic level of net exports due to the possible negative amount of net exports and the profit share is accordingly used, so as to keep variables of the same order on both sides of the function<sup>83</sup>. The sign of the coefficient of the profit share can not be anticipated because of the ambiguous effect of profits on trade.

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<sup>83</sup> As a robustness test, the use of the level of profits rather than the profit share did not change the overall effect.

$$(NI/Y)_{i,t} = \text{cons} + \gamma_1(NI/Y)_{i,t-1} + \gamma_2 \ln Y_{i,t} + \gamma_3 \ln Y_{i,t}^f + \gamma_4 \ln Y_{i,t}^d + \gamma_5 h_{i,t}$$

According to the results shown in Table 3.8, the values of the R-square statistics are not as high as in the previous functions, but they still show a good fit. Estimates and significance of coefficients are sensitive to different estimations. Coefficients of  $Y^f$  are found significant in all estimations, indicating that foreign income is an important factor in affecting Chinese regional trade.

Table 3.8: Empirical results of the net inflow function (all regions)

	Constant	NI/Y <sub>i,t-1</sub>	lnY <sub>i,t</sub>	lnY <sub>i,t</sub> <sup>f</sup>	lnY <sub>i,t</sub> <sup>d</sup>	h <sub>i,t</sub>	R <sup>2</sup>
OLS	-1.220 (0.120)	0.712 (0.000)	0.039 (0.059)	0.391 (0.055)	-0.248 (0.016)	0.005 (0.904)	0.5962
Within	-1.685 (0.063)	0.685 (0.0000)	0.036 (0.730)	0.479 (0.027)	-0.232 (0.133)	-0.177 (0.041)	0.5841
AR(1) error	-1.690 (0.138)	0.6455 (0.000)	0.0588 (0.699)	0.5218 (0.088)	-0.3023 (0.106)	-0.1641 (0.200)	0.6022
Dynamic model	-2.256 (0.080)	0.567 (0.000)	-0.536 (0.009)	0.429 (0.075)	0.360 (0.108)	-0.056 (0.734)	

#### Diagnostic Table

Modified Wald test for heteroskedasticity	Hausman Test Statistic (P)	Modified Bhargava et al. Durbin-Watson Statistics	Balagati-Wu LBI statistics	Sargan Test	Arellano-Bond test	
0	0	1.946264	2.0406625	1.0000	Order 1 2	p-value 0.0112 0.2459

Of the four estimations, the OLS estimation and the AR(1) estimation would not be taken into account due both to the ignorance of the significant state effects by OLS estimation and to the absence of serial correlation as suggested by the Baltagi-Wu LBI

statistic of 2.04 and the Bhargava et al. Durbin-Watson statistic of 1.946. In addition, the validity of instrumental variables suggested by the Sargan test and serial uncorrelated disturbances in a first differenced model indicated by the Arellano and Bond estimation allows us to choose the dynamic estimation<sup>84</sup>. As expected, the negative relationship between regional income and trade confirms the economic theory on the positive influence of domestic demand on imports. The estimate of  $Y^d$ , although it exhibits weak significance at around a 10% level of significance, shows that output in other regions and public purchases of central government also improve regional trade performance. However, the estimate of  $h_t$  is close to zero and insignificant, meaning that there is no effect of the profit share on regional trade. Since prices are generally stable across regions and the profit share influences regional trade through price variations, this lack of significance could be due to the lack of interregional price competitiveness and the dominated income effect on regional trade, especially among central and western regions. It would rupture the structure of the relationship between profits and interregional trade.

The dynamic estimation is selected for the coastal area and empirical results are presented in Table 3.9<sup>85</sup>. The short-run partial effect of the profit share on regional trade is significant at the 10% level of significance. The coefficient of  $Y^f_t$  becomes significant showing foreign income has strong effects on exports in the coastal area.

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<sup>84</sup> Considering that  $Y_{it}$  appears both in the dependent variable and independent variable which might cause the model to suffer from the correlation between the regressor and the error term, another advantage of selecting this estimation is that using first-differenced variables as instrumental variables would reduce the possible bias arising from such endogeneity problem.

<sup>85</sup> P-value of Sargan test statistic is 0.118. Arellano-Bond test also supports the application of dynamic estimation (P-value of order 1 is 0.0204 and that of order 2 is 0.1308).

The long-run partial effect of the profit share corrected by the lagged dependent variable is

$$\frac{\partial NX / Y}{\partial h} = \frac{\gamma_5}{1 - \gamma_1} = 0.243$$

Table 3.9: Empirical results of the net inflow function (coastal regions)

	Constant	NI/Y <sub>i,t-1</sub>	lnY <sub>i,t</sub>	lnY <sub>t</sub> <sup>f</sup>	lnY <sub>t</sub> <sup>d</sup>	h <sub>i,t</sub>	Wald test
Dynamic estimation	-1.19 (0.224)	0.477 (0.000)	-0.199 (0.039)	0.221 (0.144)	0.132 (0.026)	0.127 (0.079)	P-value: 0

The significant partial effect of the profit share on net inflow is 0.243, which means a 1% rise in the profit share is associated with a 0.243% rise in net outflow of goods and services. This positive relationship shows that the improvement of regional trade in the coastal area depends on large exports incurred by high price competitiveness with low wages. Since the partial effect is yielded directly and conversion is unnecessary, this partial effect is identical at both the mean levels and the 2007 levels. In contrast to the result for the whole economy, the coefficient of the profit share becomes significant because trade tends to be export-oriented in the coastal area. In this sense, international price competitiveness matters and thus the profit share has a positive impact. This finding resembles what was found in Austria and the Netherlands (0.344 and 0.202 respectively), but it is higher than most estimates for large open economies such as the UK, France and the US (Hein and Vogel, 2008).

### *Total effect*

Based on equation (16), the total effect of the profit share on aggregate demand can be calculated by the sum of the partial effects of the profit share on consumption, investment and net outflow. All partial effects and total effects of the profit share for the whole nation as well as the coastal area are presented in Table 6. For the domestic sector, the economy is profit-led due to the stronger positive effect on investment demand than the negative effect on consumption demand. The profit-led nature, yet, is weak in the coastal area. Especially in 2007, the negative impact of the profit share on consumption demand overwhelms its positive impact on investment. Taking into account the trade sector, the result for the nation as a whole remains the same because of the negligible effect of the profit share on the trade sector. The demand regime of the coastal area also exhibits a profit-led nature, but mainly because of the strong positive effect of the profit share on regional trade.

Table 3.10: Total effect of a change in profit share on domestic aggregate demand

		$\frac{\partial C}{\partial h}$	$\frac{\partial I}{\partial h}$	$\frac{\partial NI}{\partial h}$	$\frac{\partial Y}{\partial h}$
Effect for all regions	At the mean level	-0.18	0.43	/	0.25
	At the 2007 level	-0.20	0.48	/	0.28
Effects for coastal regions	At the mean level	-0.34	0.41	0.24	0.27
	At the 2007 level	-0.37	0.32	0.24	0.19

### **3.6 Conclusion and policy implications**

We investigated the effect of functional income distribution on economic growth in the coastal area and all regions of China between 1993 and 2007. Our analysis was based on a post-Kaleckian macro growth model inspired by Bhaduri and Marglin

(1990) for an open economy that allows demand growth to be wage-led or profit-led. We found that demand regimes in both China and her coastal area were profit-led. The underlying causes are, however, different in the two economies. The profit-led nature of the Chinese economy is caused by larger impact of investment relative to that of consumption, while regional trade has a negligible effect. However, there is no profit-led growth for the domestic sector of the coastal area of China because of strong consumption effects, but growth in the coastal area remains profit-led when taking into account the effects of distribution on regional trade.

As the first attempt to evaluate the demand regime of Chinese economy, our results are consistent with our analysis of the Chinese macro economic performance for the period 1993-2007. A profit-led and investment-oriented growth was proven to be the right path during the last two decades. However, we cannot assume that the present growth pattern will be appropriate for China in the future. The Chinese Enterprises Competitiveness Report (2007) revealed that the rise in profits and the induced profit-led growth are at the cost of low wage income. In fact, the wage growth of employees in non-monopolistic firms has been lower than economic growth for long period of time in China. Most entrepreneurs think that a reduction of production costs has the same meaning as a reduction of labour costs. This profit-led growth with wage moderation and resource depletion could not be sustained if external demand contracts. The continued expansion of capacity based on high expected profits will eventually cause declining prices, rising inventories and loan defaults, thus undermining entrepreneurs' investment decisions. The current global

recession seems to be a vivid but painful experience. More serious competition from other countries and the possible rising protectionism of China's trading partners during the recession could further slow down growth. Therefore, China's strong economic growth would be at risk, unless it becomes more dependent on private consumption.

Central government is indeed concerned about an unsustainable profit-led growth resulting in the lack of household consumption. Chinese premier Wen Jiabao placed emphasis on possible problems of profit-led growth, arguing that "the biggest problem with China's economy is that growth is unstable, unbalanced, uncoordinated and unsustainable"<sup>86</sup>. Our empirical results have demonstrated a tendency to wage-led growth in the coastal area lately. A disastrous recession and unemployment situation also pushes China into the transition stage. In fact, a few measures such as tax reductions and social welfare assistance for middle and grassroots classes are being adopted by the central government to stimulate domestic consumption. Statistics show that consumption growth has been the main driving force of the Chinese economy during the recession.

There are several limitations to our estimation approach that we need to recall. First, some coefficients are sensitive to the estimation we used. Although our panel estimation could provide more reliable estimates for behavioral functions (Stockhammer et al., 2009) while additional functions and methods were employed to test the robustness, they are not adequate to provide precise results. Second, some

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<sup>86</sup> In reference to Premier Wen Jiabao's speech at the National People's Congress in March, 2007: <http://news.sina.com.cn/c/2007-03-16/125012536560.shtml> (Chinese).

authors argue that data of net exports of goods and services may not be reliable because of the difficulties of statistical agencies to obtain data on regional trade. Our estimations for regional trade may suffer from this data problem. Third, the advantage of our single estimation approach is that individual effects can be identified clearly (Stockhammer et al., 2009), but it does not take into account the effect of interactions between distributional factors and demand. We simply assume distribution as the exogenous variable to examine its effects on aggregate demand and did not include simultaneity in our functions. However, we cannot ignore that real wages or the wage share might be affected by demand as well (Kaldor, 1989, p. 221). Fourth, in the net export function,  $Y_{i,t}$  appears on both sides of the equation which may cause the error term to be correlated with corresponding regressors. This potential problem has not been discussed by previous studies yet. First-differenced instruments of the dynamic estimate employed in our paper might reduce the bias but cannot resolve the problem completely. Generally speaking, our estimations have been kept simple to study the relationship between functional income distribution and economic growth. All these limitations can hopefully be addressed in future studies.

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