

Evaluating the impact of the Workfare  
Income Supplement Scheme on  
Singapore's labour market

QMSS 5999 Master's Thesis

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## 1. Introduction

In 2007, the government of Singapore introduced Workfare, with the aim of providing a social safety net for low income, elderly workers as a target group. The Workfare Income Supplement (WIS) Scheme was established as well, giving monthly supplements to these workers' earned income. This can be regarded as a new innovation in Singapore's social policy where transfers and welfare grants to the needy are rarely systematized.

This paper thus aims to firstly, explore and assess origins of this paradigmatic shift in policy. Second, it will examine the debate in Singapore's policy space regarding Workfare. In particular, it will consider the merits and costs of such a policy on drawing on literature related to similar policy forays in the United States as well the current local debate on the issue. Third, this paper will develop an empirical methodology to formally assess the impact of the scheme on labour market variables. This will be motivated by previous scholarly research on various alternative labour market institutions like unemployment benefits, minimum wage legislation, and negative income tax policies. This paper will propose that in the absence of an appropriate panel of income data, a time series analysis might be the most appropriate in determining the effect of such a policy on the variables under study.

## 2. Singapore: A background

While Singapore has seen considerable economic growth over the past decades, averaging 6.6% annual real GDP growth rate<sup>1</sup> from 1990-2010, the attendant social problems of a growing income gap, chronic poverty and a rapidly ageing population have sparked a debate in recent times as to whether the government should be changing its stance on social welfare and doing more to help poor and elderly workers. Workfare is thus seen as the first of many steps in recent years the Singapore government has taken to redress these social issues.

### 2.1 Singapore's changing socio-political landscape

A few dominant trends have been influencing the evolution of the social landscape of Singapore in recent years. First, income inequality has been "creeping up over the years" (Chan, 2007) with the Gini coefficient increasing from 0.444 to 0.478 over the years of 2000-2009<sup>2</sup> peaking at 0.489 in 2007 despite the country posting good growth figures. Secondly, Singapore is facing a fast ageing population. 8.7% of the population above 65 as of 2008 and this percentage is estimated to increase to 19%<sup>3</sup> by year 2030. Lastly, the cost of living in Singapore has been steadily increasing. The headline Consumer Price Index (CPI), which is a measure of inflation, has averaged 3.8%<sup>4</sup>, year-on-year since 2008, while wages and incomes have not kept pace. Median income has been resistant to the aggregate growth posted, while real median income has in fact fallen for the bottom 20% of the population (Ministry of Manpower,

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<sup>1</sup> 2005 Market prices.

Source: <http://www.singstat.gov.sg/stats/themes/economy/hist/gdp1.html>

<sup>2</sup> Source: Singapore, Department of Statistics, 2009, *Key Household Income Trends*

<sup>3</sup> Source: Singapore, Department of Statistics, 2009, *Population Trend*

<sup>4</sup> Source: Singapore, Department of Statistics, *CPI and Inflation Rate*

Singapore, 2011). Consequently, this has put considerable strain on Singaporeans in the lower income stratum trying to meet their healthcare and other social security needs. Public disquiet has also grown over the threat that the prevailing income gap poses to social cohesion.

These social problems have thus called into question the adequacy of Singapore's social security infrastructure, which the government of Singapore has had an active hand in shaping since Singapore gained independence in 1965. Since then, Singapore's social policy has sought to develop basic social security while resisting the institutionalization of a welfare state. Policies are often principled in a sense of non-entitlement, self-reliance and emphasize family and community support. It thus came as a surprise to some policy observers who noted the antithetical nature of Workfare and the Workfare Income Supplement (WIS) policy to "Singaporeans weaned on a strict diet of anti-entitlement and anti-dependency rhetoric" (Poh, 2007, p.48) when it was introduced in 2007.

## 2.2 Social Security in Singapore

With this, it is instructive to examine the main features of the existing social security system that Singapore has in place prior to the introduction of Workfare to gain a fuller understanding of the context in which the policy was conceived.

An important cog in the social policy machinery in Singapore is the Central Provident Fund (CPF). The fund was initially established in 1955 by the British colonial administration as a state-run provident fund and was preserved by the ruling People's Action Party (PAP) when they came into power in 1965 following Singapore's independence from colonial rule. The CPF was then conceptualized

state-run compulsory savings plan that aims to achieve social and economic security amongst the citizenry to meet the basic healthcare, investment and retirement needs of the population. It is required under the CPF system that both employers and employees make a percentage contribution of their monthly income into retirement and medical CPF accounts<sup>5</sup>. Initially, the contributions to CPF accounts were meant to provide solely for retirement needs of Singaporean citizens. This has changed over the years to permit a drawdown for investments in housing, education and healthcare. Part of the monthly contributions for instance, goes into the Medisave account, which was introduced in 1984 to the CPF. This enables members to draw on these funds for hospitalization and other out-patient expenses. Children are allowed to use their Medisave<sup>6</sup> accounts to pay for parents' healthcare requirements, and vice versa<sup>7</sup>. In short, the CPF is themed on self-reliance in the sense that the individual and family, rather than the state, is responsible for the provision of needs when one is not economically productive, due to ageing, disability or otherwise (CPF, 1995).

CPF also provides an added dimension of flexibility and potential for administering government aid. Ad-hoc transfer packages include dividends and Medisave top ups effected through the CPF pipeline, the most recent of which came in 2011 under the government's "Grow and Share" package, where the

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<sup>5</sup> As of 1 September 2011, employers contribute 16% and employees contribute 20% of their monthly wage into their CPF account, subject to a wage ceiling of S\$5,000. More information on contribution rates can be found at <http://mycpf.cpf.gov.sg/Employers/Gen-Info/cpf-Contri/ContriRa.htm>

<sup>6</sup> Medisave was introduced in April 1984 as a national medical savings account system for Singaporeans in addition to the ordinary retirement accounts in the CPF scheme. Singaporean employers and employees make compulsory contributions to this account, which can be used for hospitalization and medical expenses for self and family members.

<sup>7</sup> Information, history and details regarding CPF was obtained from the CPF website <http://mycpf.cpf.gov.sg>

government credited \$504 million to the Medisave accounts of 1.3 million Singaporean citizens<sup>8</sup>. However, such transfers have proved to be the exception to the rule in the parsimonious welfare system in Singapore. Yet, the presence of a national savings account and the system in place enables the government to make transfers to target populations in provident assets instead of disposable cash. Crucially, the WIS is administered through both cash transfers to the target population and a top-up of their CPF accounts. This feature of the WIS policy will play an important role in the subsequent analysis.

Home ownership is the next pillar of Singapore's social security infrastructure. Policymakers have often exhorted the benefits of home ownership in creating a sense of rootedness to the society, social integration and developing an asset-rich population. As a result, Singapore reports one of the highest home ownership rates in the world at 87.2% and property has a 47.2% share of total assets in the population according to the 2010 Singapore Census data<sup>9</sup>. The Housing Development Board (HDB), a public statutory board that oversees the development of public housing, is the single largest property developer in the state. Private property occupancy only accounts for approximately 10% of the total property and 82.4% of households with 2 persons or more live in public housing. Households that earning up to an income ceiling of S\$10,000 a month are eligible for HDB housing and is kept affordable by controls on market prices and supply of housing. In addition, the HDB offers favourable loan terms with concessionary interest rates to citizens who are eligible for a purchase of a flat.

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<sup>8</sup> Source: <http://www.growandshare.gov.sg>

<sup>9</sup> Sources: <http://www.singstat.gov.sg/pubn/popn/c2010sr2/findings.pdf> and <http://www.singstat.gov.sg/stats/themes/people/hhldindicators.pdf>

In 1968, withdrawals from the CPF accounts were allowed for monthly payments on HDB housing, with the aim of making home ownership a possibility without affecting disposable income (Chua, 1997). Public housing policy in Singapore was designed in congruence with the CPF scheme by providing citizens with asset-based social security (Chia, 2010) with the potential for asset appreciation and capital gains to be made on the resale market (Phang, 2007). Property assets can be monetized upon retirement (Chia, 2010)<sup>10</sup> to meet healthcare and retirement needs. The public housing scheme in Singapore thus aims to provide an extra dimension of social security in creating an asset base for the population, generating social and economic capital. Yet, despite the visible influence of the government in the design of policy, onus remains on individuals to provide for oneself.

Despite individual financing making up a significant share of spending on social security, the government of Singapore has made some basic provisions for the most needy. For instance, Medifund and Comcare are endowment funds set up by the government to aid the most vulnerable groups of society. Medifund was established in 1993 to provide assistance to needy individuals who are unable to afford basic healthcare. This is subject to a means test by medical social workers that determine the individual or family's ability to afford healthcare. The initial capital sum invested by the government was 200 million Singapore Dollars (S\$) but this has increased since to S\$1.7 billion<sup>11</sup>. Comcare benefits the elderly,

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<sup>10</sup> There are various monetizing options for a HDB flat that are summarized in Chia (2010). These include a reverse mortgage plan, buyback of leases, downsizing and subletting.

<sup>11</sup> Source: [http://www.moh.gov.sg/content/moh\\_web/home/costs\\_and\\_financing/schemes\\_subsidies/Medifund.html](http://www.moh.gov.sg/content/moh_web/home/costs_and_financing/schemes_subsidies/Medifund.html)

disabled and children of needy families and aims to work in tandem with the network of community support available through voluntary welfare organizations and the National Council of Social Services (NCSS) by funding social welfare programs. Established in 2005 with an initial capital sum of S\$500 million, the government has plans to increase this sum to a total of S\$ 1 billion. However, assistance from Comcare is contingent on strict criteria and is only temporary. The maximum duration of assistance is only 3 months, whereupon it is discontinued and individuals are expected to be self-reliant<sup>12</sup>. Like Medifund, this is a means-tested assistance program that affords benefits to those in dire need. Thus, although there is consideration the most vulnerable in society there remain stringent inclusion criteria for assistance to cultivate anti-entitlement.

In the labour market, Singapore has traditionally relied on a tripartite structure of the National Trade Union Congress (NTUC), the Singapore National Employers Federation (SNEF) and the Ministry of Manpower (MOM) to ensure, *inter alia*, a competitive labour market, fair employment practices and a flexible wage system (MOM, 2011). However, despite the active role of the government in the labour market in terms of its direct dealings with both unions of employees and employers as such there are little direct controls on the market. In particular, unemployment benefits are low and there is no minimum wage law, which is unlike many developed economies where these labour market policies have redistributive effects on social welfare.

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<sup>12</sup> Source: <http://app1.mcys.gov.sg/Assistance/CCCComCareFund.aspx>

The absence of these safety nets embodies the public ethos and attitudes towards work. This is best exemplified in the rhetoric of leading politicians in Singapore:

"We must provide this support in a targeted and sustainable way, working together with community organisations and the people sector. We must not breed a culture of *entitlement*, encouraging Singaporeans to seek Government support as a matter of right, whether or not they need it. Instead, we must foster a culture of *opportunity*, encouraging Singaporeans to see Government support as a chance for them to concentrate on acquiring new skills and jobs, and get back on their feet again... The better-off must help the poor and the disadvantaged – the sick, the elderly, the disabled and the unemployed. In many developed countries, the state takes on this responsibility, but this is invariably financed by high taxes and levies on businesses and those who are working. Our social compact is rather different. It is based on personal responsibility, with the family and community playing key roles in supporting people through difficulties. The state will provide a safety net, but it should be a last resort, not a first resort, and should focus on the minority who need help the most. We thus avoid state welfare, which will erode our incentive to achieve and sap our will to strive. Our social compact enables us to keep taxes low, and lets people keep the fruits of their labour and businesses the rewards of their enterprise. And when we do well and have budget surpluses, we can distribute some of them back to Singaporeans."

-Prime Minister Lee Hsien Loong, in speech for the 2005 Budget.<sup>13</sup>

The resultant effect is a raft of social policies designed to dovetail economic policies ensuring there is no substantial trade-off between growth and societal well-being.

### 2.3 The welfare state in Singapore

PM Lee had also noted the contrast between the Singapore welfare state and that of many other developed countries, a view shared by many scholars and observers of social policy. In his seminal work of the worlds of welfare capitalism, Esping-Andersen (1990) conceptualized three different welfare regimes according to the qualitative differences in their approaches to the

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<sup>13</sup> Source: [www.mof.gov.sg/budget\\_2005/.../FY2005\\_Budget\\_Statement.doc](http://www.mof.gov.sg/budget_2005/.../FY2005_Budget_Statement.doc)

institutionalization of the welfare state. According to his survey of 18 states<sup>14</sup> and their approach to social welfare, he defined distinct worlds within a domain of capitalist states that extended welfare provisions to its peoples as a matter of their social right. Esping-Andersen further claimed that these countries differed in the 'quality of social rights, social stratification and the relationship between state, market and family' (p.29). In the social democratic world for instance, welfare regimes are characterized by a high conferment of social rights unto the people by the state, where welfare is provided by the state instead of the market, and as a result, social stratification is normalized according to how much an individual or a family can attain. Scandinavian states like Norway, Finland and Denmark exist in the social democratic world of welfare capitalism. On the other hand, The United States, Canada and Japan are held up as examples of regimes in the "liberal" world. Here, social rights are minimal; the market provision of welfare is encouraged and whilst there is an equalization of a minimum standard of living for those living in poverty, wealth is stratified for the majority via market mechanisms. In countries like France, Belgium and Germany, which existed in the conservative world, social rights were rather extensive and existing social strata were preserved by the public welfare regime. The simple but powerful framework set out in Esping-Andersen precipitated a strand of comparative analysis on social welfare, employing his taxonomy in scholarly work on stratification studies and social policy.

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<sup>14</sup> The 18 countries surveyed were: Norway, Sweden, Denmark, Finland, Netherlands, Switzerland, Canada, United Kingdom, Germany, Belgium, Australia, New Zealand, Austria, France, Japan, Ireland, Italy and United States.

In the case of Singapore, scholars have tended to agree that the welfare regime in Singapore is discordant with any of the worlds as established in Esping-Andersen's work. Holliday (2000) asserts that East Asian states have a different approach to welfare capitalism in what he terms "Productivist Welfare Capitalism", a distinct ideology from the systems in the original Esping-Andersen taxonomy. According to him, the principal driving forces in such a concept of welfare capitalism is growth-orientation of the state and a subordination of social policy to economic policy. This is evident, he argues, in several East Asian states including Singapore. Consequently, the system that exists in these states affords social rights insofar as it does not affect productivity. There also exists the reinforcement of inequality and stratification processes along productive elements in society. Singapore however, stands out amongst East Asian states in that the active interventionist approach by the state is particularistic and not universal. Jones (1990, 1993) brings to light the shared values of Confucianism amongst East Asian welfare states. Since Confucianism is a fundamental philosophy amongst East Asian societies called for the provision of the vulnerable and needy as an integral part of family and community ethos, there was little or no call in public domains for welfare services as in Western societies, breeding a unique strand of East Asian welfare regimes. Aspalter (2006) further asserts that social policy was not in fact subordinated (as Holliday would claim) to economic policies in an East Asian welfare model; that the two were synergized and worked in tandem with each other. Further, he argues that while family and the market play the requisite role in welfare provision, the state sees itself as a key regulator in the welfare regime.

It is thus clear that although scholars differ on how the government of Singapore is motivated in its conduct of social policy, they largely agree on the fact that it is in fact, a distinct welfare regime from much of the developed world. In essence, the basic welfare needs of Singapore's population have been met via the devolution of such responsibilities to individuals, families and the community. The role of the state has been circumscribed to that of engineering an asset base for the security of its citizens, whilst ensuring a steady growing pool of wealth in the country for its development.

In contrast to the US policy experience, we find that there are several key differences that exist between the social security systems in place. Although the goals of the CPF system and Social Security, otherwise referred to as the Old-Age Survivors and Disability Insurance (OSADI), are similar in the sense that they both aim to provide retirement income, they differ in terms of the mechanisms that benefits are administered post retirement. Essentially, the CPF scheme works as a defined contribution pension plan, meaning that benefits accrued to pension holders are determined at the time of retirement, while Social Security is a defined benefits pension plan, meaning that the amount of benefits are determined pre-retirement, as an actuarial function of present income. However, defined benefits pension plans as such tend to provide an incentive for lower-income workers to contribute more to the plans due to the higher imputed benefits accrued post-retirement. Correspondingly, the CPF system might resemble the 401(k) retirement savings plan where employers and employees contribute monthly to a savings, where these are tax-deferred. Notably, with

defined contribution plans, there is no additional incentive for lower-income workers to contribute more to their post-retirement income as a defined benefit plan like Social Security would. Workfare thus complements the existing CPF system by creating additional incentives and supplements to lower-income workers post-retirement income and aiming to construct a robust social safety net.

However, this paper contends that Workfare and its accompanying policies have marked the beginning of a paradigmatic shift in perspectives and ambitions for the role of the Singaporean government in its provision of welfare. With the advent of a new socio-political paradigm precipitating in the enactment of Workfare policies, it is appropriate to consider in greater detail what the underlying policy motivations are. Section 2.1 highlighted in brief the manners in which growing trends of income inequality, wage stagnation and an ageing population have influenced the socio-political context.

Yet, one could argue these trends are only symptomatic of a systemic instability that has lent impetus to such a shift in social policy objectives. Some policy observers have noted that the government was indifferent to trends of poverty and inequality in past recessions, attributing it to the booms and busts of a business and economic cycle and administering ad-hoc programmes for social assistance (Poh, 2007), while others noted the wisdom of "focus on enlarging the economic pie rather than its distribution" (Chia, 2010, p.101) often cited by the government in resistance to sanctioning redistributive social policies, in pre-Workfare debates. The rhetoric has since changed with the implementation of

Workfare. The government has become more attentive to the potential structural imbalances in the labour market have caused social inequality and threaten to perpetuate it. Poh (2007) highlighted that from the years 2000 to 2005, a third of the bottom quintile of wage earners had below secondary education while 24% of them only had secondary education. This has decreased their employability to the middle to top end of the wage scale. At the bottom end, Bhaskaran et al. (2012) point out that low-wage workers face increasing competition from the global labour market, of which China and India have been major contributors. The surge in technological innovation in recent drives a wedge between skilled and un-skilled workers, and puts low end jobs at risk of redundancy due to technological substitution. The social immobility that is implied by the increasing income inequality thus characterizes deeper structural malignancies and immobility in labour market that the Singaporean government has attempted to arrest with the introduction of Workfare.

There are significant political motivations for such a move towards Workfare as well. Pressure had been steadily increasing on the government to address social issues, putting a spotlight on social policy and income inequality in the recent 2011 General Elections in Singapore. Remarkably, the ruling People's Action Party (PAP) that has been in power since Singapore's independence in 1965 saw its share of the popular vote sink to a historical low of 60%, with public discontent towards the party's policies palpable. Indeed, Bhaskaran et al. (2012) outline three aspects in which the government's economic policies have amplified the polarization of the bottom and top ends of the income distribution. First, the tax structure has evolved over the past decade to a more regressive one,

with a reduction in personal income tax and a corresponding increase of sales tax. Second, immigration policies have been “excessively liberal” (p.9), depressing low-end wages with the influx of foreign low-skilled labour and raising competition and wages at the top with high-skilled labour. Third, policies directed at attracting global elite talent have created “agglomeration effects” (p.9) that confer significant returns to the middle to upper class, but create negative externalities like congestion and rising house and commodity prices. However, the government has introduced measures for the lower income stratum in recompense, signaling an increased political will to counterbalance the effects of these policies on the income distribution. For instance, while cash vouchers have been distributed to needy families with each hike in sales tax on a one-off basis, this has been changed in the most recent budget, where it was announced that these vouchers were to be disbursed on a permanent basis instead<sup>15</sup>. Arguably, the move to Workfare can be seen as a similar response to the growing political pressure that the PAP-headed government has faced in recent years.

#### 2.4 Workfare: a new paradigm

The Workfare Income Supplement (WIS) Scheme was established in 2007, and since then an umbrella of policies has been established under the ambit of “Workfare”. WIS was introduced in the 2007 Budget<sup>16</sup> in Singapore, targeting low-wage, elderly workers. The Workfare Training Support (WTS) Scheme was initiated in 2010 as a complement to the WIS, providing skills upgrading to the

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<sup>15</sup> Source: [http://www.singaporebudget.gov.sg/budget\\_2012/budget\\_speech.html](http://www.singaporebudget.gov.sg/budget_2012/budget_speech.html)  
The Goods and Sales Tax (GST) Vouchers that help to offset the increase in sales tax will be disbursed on an annual basis to lower-income families. They will be paid in cash, credits for utility bills and credits to their Medisave accounts.

<sup>16</sup> Information regarding the Workfare was obtained from [www.workfare.sg](http://www.workfare.sg).

same target population in a three-year long programme. In addition, the Workfare Special Bonus (WSB) was also announced in 2010 as an ad-hoc benefit package for the same group of workers. The government is expected to spend S\$450 million on the WSB and these cash benefits will be disbursed over three years starting in 2010. Thus, as a raft of policies, Workfare aims to add a dimension to the social security infrastructure of Singapore to afford opportunities to low-wage workers to be more self-sufficient and to facilitate upward mobility (Poh, 2007). However, the introduction of the WIS scheme is the most significant as for the first time in Singapore's history, welfare benefits have been systematized as a means to alleviating the burden of inequality, inflation and an ageing population and thus the institutionalization of the WIS scheme will be the main focus of this paper.

Under the WIS set up, workers over the age of 35 earning up to S\$1,700 of monthly income are entitled to supplements to their salary and CPF accounts. WIS is an earned income subsidy programme, which implies that a citizen is eligible for benefits if and only if he or she is in employment<sup>17</sup>. At the same time, employer CPF contribution rates for elderly workers have been reduced. This implies that the burden on employers towards their employees' social security has decreased under the WIS policy. Workers are also required to stay employed for at least a 3-month period out of any 6-month period in any given work year. WIS is means-tested, meaning that it disqualifies people with low incomes if they have greater wealth in assets. The scheme is expected to affect 400,000 citizens, which stands at about 10% of the resident population in Singapore and to cost

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<sup>17</sup> Self-employed citizens receive the full supplement only through their Medisave accounts.

the government about \$400 million a year. The monthly supplements are graduated according to the workers' income and age bracket. Figure 2.1 details in a bar plot the monthly supplements in cash and CPF contributions given to workers in a particular age bracket and income.



Figure 2.1 Bar plot detailing monthly Workfare Income Supplements given to workers across income and age groups<sup>18</sup>.

The bar plot reveals three main features about the WIS. First, the cash and CPF quantum strictly increases with age; older workers are entitled more supplements. Second, within each age bracket, supplements peak at the mid-way through the average monthly income range for which a worker qualifies for WIS; the cash and CPF quantum received is directly proportional to monthly income. This implicitly incentivizes productivity, as there are increasing returns to income if a worker is able to move up from the bottom end of the wage scale.

<sup>18</sup> Source: [http://mycpf.cpf.gov.sg/NR/rdonlyres/2BE8F97B-E10C-4BC9-BC86-2D60C6B0C162/0/WIS\\_EEBenefits.pdf](http://mycpf.cpf.gov.sg/NR/rdonlyres/2BE8F97B-E10C-4BC9-BC86-2D60C6B0C162/0/WIS_EEBenefits.pdf). Correct as at Dec 2010.

However, supplements these taper off towards the top of the eligible income bracket so as to prevent a sudden discontinuation of aid at the margins of those who need assistance (Lee, 2007). Third, the supplements are distributed mainly to the workers' CPF accounts. Hence, most benefits received by the eligible workers are to their savings and not their salary accounts<sup>19</sup>. These workers and their employers also contribute less to their CPF accounts, thereby increasing the workers' disposable income and employability, while the government has underwritten the outlay for these reduced contributions. As evident, the design of the scheme is deliberate and directed in its efforts in sustained assistance for this group of workers. At the same time, the government has reaffirmed that it has not departed from the fundamental tenets of the Singaporean philosophy towards welfare when the WIS scheme was enacted in 2007:

"Many other developed countries have addressed the problems of the low income group often through extensive social welfare programmes. But Welfare has drained fiscal resources and, more damagingly, eroded the work ethic and encouraged an entitlement mentality. The more successful model of assistance has been Workfare — which seeks to supplement the incomes of low-wage workers on the principle that the best way to help people is to help them find work and stay in work... The Workfare Income Supplement scheme is a major policy change. For the first time, the state will be supplementing the market wages that low-wage workers receive. But we have decided to make this change so as to help low-wage workers and encourage them to stay employed. This will strengthen social inclusion in Singapore."

-Prime Minister Lee Hsieng Loong in his 2007 Budget Speech, announcing the implementation of the WIS scheme.  
The socio-political climate as presented in the preceding sections has galvanized a political will to enact policies to buttress the social compact of Singapore, though it has retained much of its traditional perspectives on social welfare. The result is a multi-pronged approach to social security that Workfare is now an

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<sup>19</sup> The ratio of cash to CPF supplements is 1:2.5.

integral part of. Figure 2.2 summarizes the main elements that constitute the infrastructure that has prevailed with the introduction of Workfare.

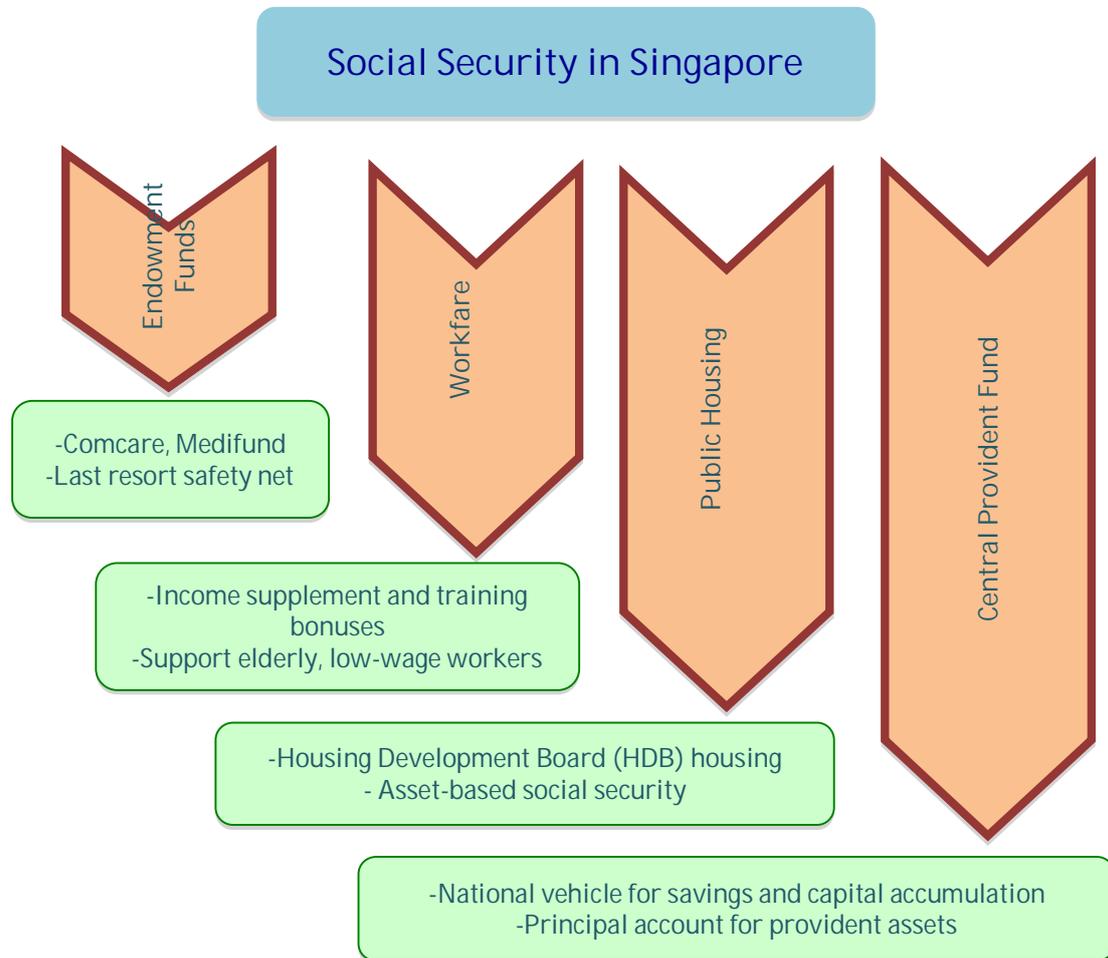


Figure 2.2. The four key pillars of the social security infrastructure in Singapore.

This schematic illustrates the various levels of assistance and security available to various segments of the population. The vulnerable minority has access to the endowment funds, while the slightly broader pool of elderly low-wage workers receive regular earned-income supplements and training benefits. Public housing is made affordable to the wider population to provide asset-based social security, and all working citizens have at least a CPF account to accumulate provident assets to provide for their healthcare and retirement needs.

### 3. The impact of Workfare

In essence, the WIS scheme embodies the thrust of the Workfare philosophy, enhancing the incentive for low-wage, low-skill workers to be upwardly mobile in the labour market and in society as well. At the same time, it should reward and thus encourage work, increasing the supply of labour in the economy (Besley & Coate, 1992). Similar negative income tax policies in the United States as proposed by Friedman (1962) and advocated by Tobin et. al (1967) and Lampman (1965,1968), amongst others, cite comparable arguments in favour of such a scheme. Friedman (1962) called for the tax to be integrated with the tax system and administered through the Internal Revenue System and further argued they compare favourably to artificial controls like minimum wages and tariffs, which distort market signals. Other advantages, he argued, were the reduction of stigmatization of the poor and the saving of administrative costs due to the integration with the tax system.

These policies were hugely popular in the 1960s and had spawned several negative income tax experiments<sup>20</sup> in the United States. However the findings from these experiments have been equivocal, with several studies finding an ambiguous response supply of labour (Moffitt, 2003) and sometimes even a negative response (Burtless and Hausman, 1978, Robins, 1985). This result, so it was argued, was due to the fact that the income supplement guaranteed on top of welfare transfers created a disincentive to work. On top of that, receipt of such a benefit was contingent on onerous work requirements that deterred recipients

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<sup>20</sup> These experiments took place between 1968 to 1982 in New Jersey and Pennsylvania, Iowa and North Carolina, Gary, Indiana, and Seattle and Denver. Reports and data from the experiments can be found at [http://www.irp.wisc.edu/research/nit/NIT\\_index.htm](http://www.irp.wisc.edu/research/nit/NIT_index.htm)

of a negative income tax from more work. There was also an associated marriage penalty with the negative income tax (Alm et. al, 1999), which deterred recipients from getting married, as their combined income would disqualify them from such aid. Furthermore, income obtained from welfare transfers qualified as income by tax definitions and thus ran contrary to the ethos behind such a policy. Thus, it is not clear from previous policy experiments in the United States whether negative income taxes have a clear effect on the supply of labour amongst the target population.

Yet, certain features of the WIS scheme set it apart from the negative income tax policy originating in the United States in the 1960s. Firstly, the policy context in which the WIS scheme was framed lends itself to less of the attendant issues that the US policymakers faced with the welfare system that was in place. Welfare transfers, which are minimal under the welfare regime in Singapore, do not interfere with the policy mechanisms of the WIS scheme. Secondly, the WIS scheme is integrated with the CPF system, which is based on contributions from individual earned income and wages, and avoids the problems associated with the tax system in terms of marriage penalties as well. Third, the WIS scheme does not only supply cash outright but supplements the retirement and medical account savings of elderly workers. The social benefit accrued to elderly workers with the provision of greater retirement wealth and increased access to better healthcare is a labour incentive effect that is not produced by a negative income tax policy. Thus, even after taking into account the US' negative tax experience, the WIS scheme should have a positive impact on labour supply. In fact, the negative income tax policy was revived on a large scale under the Reagan and

Clinton administrations with the tax being revised to an Earned Income Tax Credit (EITC) where a tax credit is given based on earned income from wages and salary and is the largest poverty reduction programme in the US with 21 million American families receiving over US\$36 million in aid today. Eissa and Liebman (1996) and Ellwood (2000) find positive empirical results in favour of such a scheme, particularly for the labour supply of single women with children. With these revisions, the EITC is arguably more aligned to what the WIS scheme aims to achieve in terms of a labour supply response and WIS is a direct transposition of the EITC to the Singaporean context (Lee, 2007).

Recent evidence of the impact of WIS has revealed that the policy has been well received. A study by Soon et al. (2012) in Singapore supported the theory that the majority of low-wage workers preferred a higher CPF component in the WIS quantum, as opposed to pure cash. 1,000 Singaporeans<sup>21</sup> were polled in a survey and were posed 10 scenarios, each with two different packages with almost identical value: a pure cash package, or a mix of cash and CPF, and were asked to choose between the two. Only 14% of respondents always chose cash for all 10 scenarios, demonstrating that the majority low-wage workers do prefer a transfer in CPF assets as in the design of the WIS Scheme. Furthermore, in their study, they cite several other findings in favour of issuing the WIS grant through CPF accounts. For instance, Beshears et al. (2011) found through an experiment that people preferred longer term, more illiquid accounts to liquid accounts that permitted more withdrawals, indicating that assets in savings accounts are

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<sup>21</sup> These comprised mostly of elderly low-wage Singaporean workers with low levels of education.

valued more highly than liquid cash. While the study by Soon et al. revealed the liquidity preferences of low-wage workers, there are certain limitations of the study that this paper hopes to address. First, the set-up of the scenarios did not mirror the ratio in which the WIS quantum is actually administered. Eligible workers receive cash and CPF payouts in an approximate 1:2.5 ratio, while the study weighted the cash component significantly higher. Indeed, there have been calls amongst politicians<sup>22</sup> for the cash component of the WIS payouts to be increased to cope with rising inflation in Singapore. Second, the study only reveals preferences of workers, but does not examine their behaviour or decision to work more or less given supplements to their income. Thus, it is unclear if the incentive of provident assets offered to workers via the CPF pipeline is sufficient for workers to enter the workforce, as opposed to a pay out that is disbursed with a higher cash component. Third, the study was conducted at a micro-level, as with the studies regarding the EITC as presented earlier. They might not reveal the big picture dynamics of how the economy has responded to the policy. Of particular interest is if WIS has affected the incentive to work, and thus labour supply. Another concern is that workers may be put off from raising their productivity near the top of the eligible income bracket to qualify for WIS benefits. Hence, with the WIS scheme still in its infancy and no formalized academic study being undertaken on its impact, this paper hopes to shed light on how the nascent strategy on social policy has affected Singapore since its

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<sup>22</sup> Member of Parliament Zainal Sapari told the Straits Times he believed that the respondents who always preferred the CPF combination package understood the need to save for retirement, those who chose cash were likely to be struggling to cope with the cost of living. He was interviewed for the article "Many low-wage workers prefer Cash plus CPF mix" published in the Straits Times, 11 Aug 2012.

introduction in 2007. The following section will present a formal research statement and discuss an empirical approach to study its impact.

#### 4. A framework to evaluate WIS

With the integration of the Workfare into the social security system, it is instructive to examine the issue of whether WIS has been a *viable* social policy since its inception in 2007. At the core of this is the question of whether WIS has been able to provide the targeted and sustained assistance to low-wage workers and at the same time, in line with the philosophy of Workfare, rewarding work with benefits and increasing labour supply. It has also been a contentious issue if supplementing workers' CPF accounts has been the best method to induce an increase in labour supply. This paper thus aims to investigate the main hypothesis that the Workfare Income Supplement Scheme has incentivized work in Singapore's labour force and increased labour supply. It will also aim to assess the effectiveness of using the CPF system to administer the WIS payouts as a secondary hypothesis.

##### 4.1. Literature Review on methodology

An experimental methodology would offer clearest recourse to a causal understanding of the relationship between the dependent and independent variables (Woodward, 2003). Under such an experiment, there would be groups assigned a treatment and control status, with the treatment being in this case, being placed under the WIS scheme.

There are several ways of conceiving such an experiment as discussed by previous literature. Falk and Huffman (2006) analyze the effects of labour supply under different labour market institutions – minimum wages, employment protection and workfare using a controlled lab experiment that is a randomized experiment run in a controlled environment posing different work situations to subjects and inferring relevant reservation wages and labour supply levels. However, while causal inferences based on such controlled randomized experiments provide evidence that is internally valid, there are broader issues when relating to generalizability and representativeness of the subjects sampled. Most questionable however is the assumption of an exogenous labour institution change or shock in a controlled randomized experiment, which seem to be at best, a caricature of the actual dynamics in the economy.

Generally speaking, field or natural experiments have seemed to be the principal method in inferring the impact of such policies. Card and Krueger (1994, 1995) famously argued the case for a minimum wage by using a case study comparing employment effects in neighbouring states of New Jersey and Pennsylvania, after there was an increase in the minimum wage of New Jersey. Designating New Jersey fast-food restaurant workers as the treatment and eastern Pennsylvania fast-food restaurant workers as the control, they employ a natural experiment methodology to make a claim on the effect of a minimum wage. They observed that minimum wage had little effect in affecting employment growth based on their survey of the fast food industries in these two states.

Panel data has also been widely used in the literature used to study labour institutions. For example, Dickens, Machin & Manning (1999) employ a fixed-effects model using a panel data set in the UK to determine the effects of a minimum wage on employment. Ellwood (2000) relies on panel data obtained from the field experiments to employ a difference-in-differences (DID) approach to determine the effect of the EITC on labour supply, marriage and other living arrangements, while Robins (1985) average labour supply over time to determine the response to a negative income tax.

Returning to the WIS scheme, Adireksombat (2010) advocates the use of a DID framework to analyse such the WIS, designating the use of the 25-35 age group as a control group who are not eligible under the scheme in the DID analysis, and four different treatment groups stratified by ages 35-45, 45-55, 55-60 and above 60. There are several problems relating to such an analysis. Firstly, the dependent variables to be analysed differ structurally across different strata of age; a low-wage worker in his or her 20s might have very different reasons for not entering the workforce as compared to a low-wage worker in his or her 60s. Secondly, a panel study that would be comprehensive enough to control for all relevant confounding influence that might pertain to labour supply has not been undertaken, given the nascency of the WIS policy.

Hence, in the absence of a viable panel of data, this paper proposes a time-series analysis with the aim of attributing the impact (if any) of the WIS scheme in terms of labour supply. Time series data is easily accessible from public sources and is available as aggregate data. This rules out any conventional selectivity

issues inherent in an experimental design (Muthen and Jöreskog, 1983). While the lack of resolution and precision in discerning the micro or individual level impact is an obvious limitation in time series analysis- acknowledged by several other researchers on estimating aggregate labour supply (Rosen & Quandt, 1977 and Ashenfelter, 1980)- variables like labour supply are easily operationalized using unemployment rates and such an analysis it can provide the macro-level diagnostic for a policy such as WIS paving the way for further micro-level attention.

Arguably, the main disadvantage of time series analysis is a lack of intuitive understanding of the notion of causation. While causation is intuitively accessible with the use of counter-factual arguments in an experimental framework, temporal order of data points add a different dimension in defining casual relationships. Granger (1988) attempts to define a notion of causality based on temporal ordering, with Granger & Newbold (1973) having earlier warned against the nature of spurious relationships in regression analysis of any given non-stationary variables. This has uncovered a body of research explicating the notion of causality and causal structures. Structural vector auto-regressions take into account contemporaneous effects of endogenous variables (Lütkepohl, 2005) while impulse response functions can be used to determine the size of a policy response (Swanson and Granger, 1996, Pesaran and Shin, 1997). Carneiro (2000) employs a time series analysis in determining the impact of a minimum wage in Brazil and conceptualizes long-run and short-run dynamics in the labour market taking into account changes in aggregate output

as well. Box and Tiao (1975) propose a methodology that quantifies the *intervention effects* of a given stimuli or shock to an environment in a time series framework. This paper will attempt to draw on these researchers' work to develop an empirical methodology for inferring the influence of the WIS policy on the levels of labour supply.

#### 4.2 Variables and data

The research hypothesis as presented in the preceding section implies that the main variable to be considered in the analysis are the levels of aggregate labour supply and aggregate CPF contributions should figure as an independent variable in the secondary hypothesis. Aggregate time series data was obtained from the Ministry of Manpower, Central Provident Fund (CPF) Board, and Department of Statistics, Singapore<sup>23</sup>. Since the focus of this paper is the significance of the WIS program on the resident labour force, we require only data pertaining to resident workers. Conveniently, the CPF Board maintains quarterly administrative records on the number of resident workers that are in employment as it is membership to the CPF Board is compulsory for every employed citizen. Numbers on self-employed residents, unemployed residents and hours worked are updated through a monthly survey of 10,200 households known as the Labour Force Survey. The survey is administered online, over the phone and using face-to-face interviews. The data is consolidated and reported at an aggregate level and the aggregate data will be used for the analysis. The

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<sup>23</sup> Data was collated from the quarterly reports of the CPF Board and the Ministry of Manpower websites and can be found here at the following addresses: [http://mycpf.cpf.gov.sg/CPF/About-Us/CPF-Stats/CPF\\_Stats.htm](http://mycpf.cpf.gov.sg/CPF/About-Us/CPF-Stats/CPF_Stats.htm) and <http://www.mom.gov.sg/statistics-publications/national-labour-market-information/publications/Pages/default.aspx>.

CPF Board also maintains an administrative records of the contributions made by members, which will be used to characterize the independent variable. With transfers to workers' CPF accounts being the main apparatus of the WIS scheme, the changes in the levels of CPF can articulate the impact of the Workfare on the levels of labour supply in Singapore.

### *Labour Supply*

The number of hours worked by the active resident labour force per week is used as a measure of aggregate labour supply. While there was no direct measure of this variable, data on employment and hours worked were kept by the ministry and were used to derive the total number of hours worked per week by the active resident labour force. Let the average number of paid hours worked per week in quarter  $t$  be  $h_t$ . This was defined as the number of hours worked in a standard 5-day work week including over-time for a worker in employment. Also obtained was the number of unemployed workers (seasonally adjusted) in quarter  $t$ ,  $l_t$ . An unemployed person is defined as a person aged 15 or over, who is not working but available for work and actively looking for a job during a given period. Seasonal adjustments imply that the expected periodic fluctuations to the unemployment numbers are removed, and we observe the fluctuations due to the general trend and random variation from quarter to quarter; Lastly, using the seasonally-adjusted unemployment rate in quarter  $t$ ,  $u_t$ , the total resident labour force in quarter  $t$ ,  $L_t$  is recovered using the formula:  $L_t = (1 - u_t) * l_t / u_t$  and the product of average hours worked per week and total resident labour force is used to derive the total number of hours worked per week by the

resident labour force in quarter  $t$ ,  $H_t$ , such that  $H_t = L_t * h_t$ . The unemployment rate is defined as the percentage of unemployed persons to the total labour force, which is the number of economically active persons above the age of 15, employed or unemployed<sup>24</sup>. Naturally, this measure of aggregate labour supply has its advantages and disadvantages and this merits further discussion, which will be presented in the latter part of the paper. For now, the analysis will assume the methodology for measuring labour supply as given and adequate.

A time series plot of the total number of hours worked per week by the resident labour force is shown below, plotted on a logarithmic scale.

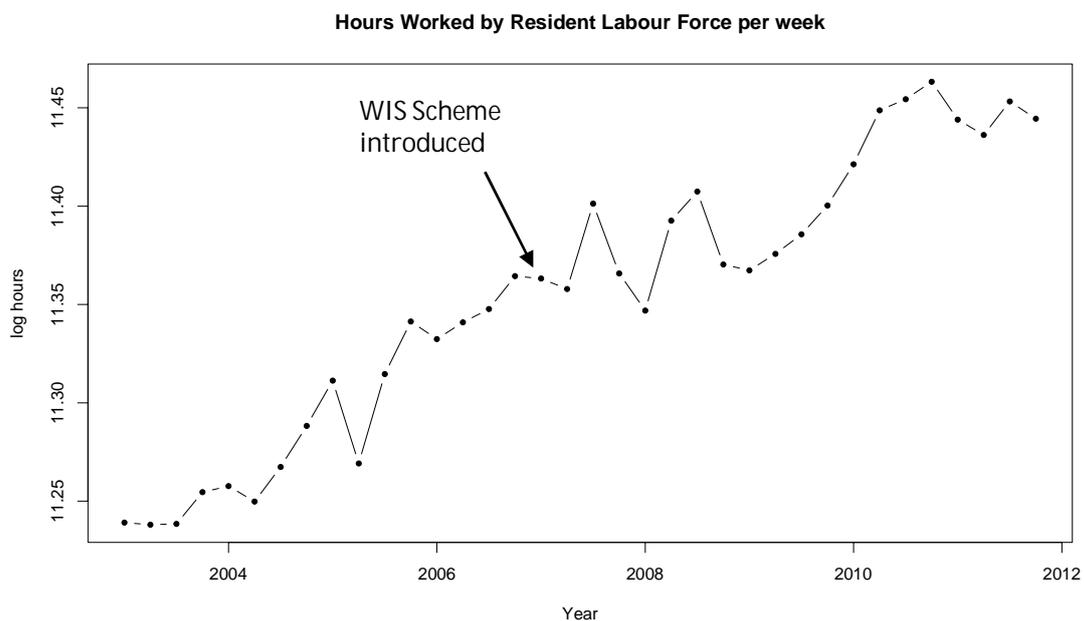


Fig 4.1. Total hours worked per week by resident labour Force in log hours in each quarter from 2003-2011 (seasonally-adjusted).

<sup>24</sup> The definitions of these as established by the Ministry of Manpower, Singapore can be found at [http://www.mom.gov.sg/Documents/statistics-publications/Data-Definition/mrzd\\_DataCnDnSource.pdf](http://www.mom.gov.sg/Documents/statistics-publications/Data-Definition/mrzd_DataCnDnSource.pdf).

The time series plot shows a steady upward trend, with fluctuations about a moving average. There is no evidence of periodicity from the plot. This is to be expected given that the employment figures have been seasonally adjusted and there are no systematic seasonal fluctuations in the data. It is also not apparently obvious that the introduction of the WIS program has caused a significant alteration in terms of labour supply in the years after the WIS scheme has been introduced. While this plot serves as a general picture of how labour supply has responded to the WIS policy in aggregate terms, more detail is needed in the subsequent analysis to deduce the extent of the policy impact.

#### *Central Provident Fund (CPF) Contributions*

Since 71% of the total stipend given to the lower-income workers under the WIS scheme are credits to the workers' CPF accounts, it would be instructive to consider the influence of contributions to CPF accounts on labour supply, or the marginal impact of an extra injection of CPF funds on aggregate labour supply. For the WIS scheme to be effective in incentivizing work, an exogenous increase in total CPF contributions as implied by the WIS scheme should have a positive impact on labour supply. Quarterly data from the years of 2003-2011 was collected from the CPF Board, Singapore and this details the total CPF contributions from the resident labour force in each quarter. A slight limitation of the data is that while the Ministry of Manpower has maintained employment data since 1990, the CPF Board has published data only since 2003. Thus, quarterly employment and CPF data is limited from the years of 2003-2011. This

results in a 36 observations over a 9-year period. The total gross CPF contributions in quarter  $t$  is denoted by  $P_t$ . Fig 2.1 shows a time series plot of the quarterly CPF contributions.

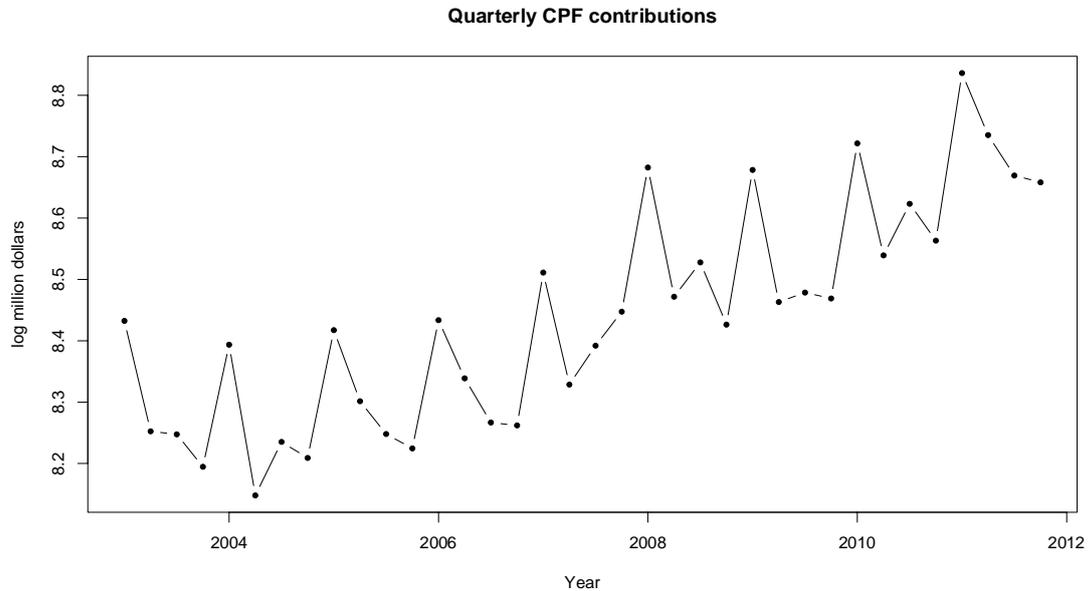


Fig 4.2 Total CPF contributions by resident labour force in S\$ millions each quarter from 2003-2011.

There is a slight but apparent upward trend in the data, along with annual periodicity where the peaks of each period correspond to the end of the fiscal year. This could correspond to the end-of-year bonuses that salaried employees receive at the end of the year.

In sum, this paper will analyse the impact of the WIS policy through a main response variable, characterized here as aggregate labour supply. The primary apparatus of the program is the injection of credits to workers' CPF accounts; the relationship between the two will be examined through a theoretical time-series framework. This enables us to test the contention that Workfare is able to

reward work for low-wage workers and induce them to increase their supply of labour, which will be observable at an aggregate level.

#### 4.3 Time Series Framework

This paper will apply univariate time series analysis as detailed in Box & Jenkins (1976) and multivariate analysis as in Brockwell & Davis (2001) and Lütkepohl (2006).

Time series regression analysis stands in contrast to typical Ordinary Least Squares (OLS) regression analysis with a high degree of auto-correlation in the data and there exists a degree of dependence of the data on its recent past. In OLS regression, observations are assumed to be independent and identically distributed, and error terms are uncorrelated. This tends not to be the case for time series data. Box and Jenkins formalized a modelling procedure for a class of autoregressive, integrated moving average (ARIMA) models that characterizes the structure of the data based on the data's past values and a 'noise' component. Formally, an ARIMA( $p, d, q$ ) model for a data series  $Y_0, \dots, Y_T$ , obtained at regular time intervals is given by

$$\phi(B)(1-B)^d Y_t = \theta(B)\varepsilon_t, \quad (4.1)$$

where  $B$  is the backshift operator such that  $BY_t = Y_{t-1}$ ,  $\{\varepsilon_t\}$  is a series of independent and identically distributed (i.i.d.) normal random variables with mean zero and constant variance,  $\sigma^2$ .  $\phi(B)$  and  $\theta(B)$  are polynomials in  $B$  of degree  $p$  and  $q$  respectively such that  $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \dots - \phi_p B^p$  and so on.  $d$  refers

to the order of *integration* of  $\{Y_t\}$ , a concept that will be discussed later on in parallel with *stationarity*.  $\phi_1, \dots, \phi_p, \theta_1, \dots, \theta_q$  are parameters to be estimated in the model and they parameterize the dependence structure of the data on its past and the contribution from random variation or the 'noise' terms respectively.

In the multivariate case, which is in essence a generalization of the univariate procedure, we consider vectors of  $m$  relevant variables collected at regular time intervals  $Y_0, \dots, Y_T$  and  $Y_t = (Y_{1t}, \dots, Y_{mt})'$  and is defined similarly:

$$\Phi(B)(1-B)^d Y_t = \Theta(B)\varepsilon_t, \quad (4.2)$$

where  $\Phi(B)$  and  $\Theta(B)$  are matrix polynomials of degree  $p$  and  $q$ , and  $\{\varepsilon_t\}$  is a series of multivariate normal vector noise terms with mean 0 and covariance matrix  $\Sigma$ .  $\Sigma$  is an  $m \times m$  diagonal matrix with diagonal entries corresponding to the error variances of  $\{\varepsilon_t\}$ ,  $\sigma_1^2, \dots, \sigma_m^2$ . Importantly, these models represent the dependence structure that exists within the data with the parameters that are estimated. These can be applied and interpreted intuitively within a broader framework that will relate to the context of this paper. The technical details pertaining to the modelling process will be omitted from this paper and the basic univariate ARIMA or multivariate Vector Autoregressive, Moving Average (VARMA) models presented from hereon in the paper will be the 'final' models resulting from the modelling process, but the interpretations and the model application will be discussed at greater detail.

#### 4.3 Preliminary Analysis

This section will highlight certain features of the data that merit further attention before applying the Box-Jenkins procedure to the data series.

### *Auto-correlation*

Box & Jenkins modelling, the auto-covariance structure of the data is utilized for modelling, forecasting and casual analysis. The auto-correlation function (ACF) is used as a metric to measure the degree of correlation between a variable's present value and its past.

Formally, the ACF of a series  $\{X_t\}$  at lag  $h$  is defined as

$$\rho_x(h) = \frac{E[(X_t - \mu)(X_{t+h} - \mu)]}{\text{Var}(X_t)}, \quad (4.3)$$

where  $\mu$  is the mean of  $\{X_t\}$ . This function thus describes the lagged dependence of  $\{X_t\}$  on itself,  $h$  lags ahead. As with a typical correlation coefficient,  $\rho$  takes values between -1 and 1, where  $\rho = \pm 1$  describes complete deterministic dependence, and  $\rho = 0$  is interpreted as independence. For instance, if  $\rho_x(1) = 1$ ,  $\{X_t\}$  is completely dependent on its immediate past, ie. at lag =1. In practice, the sample analogue of the ACF is computed and this gives an indication to the extent of auto-correlation that exists within a series.

Similarly, one can consider the cross-correlation between two series, where in this context  $\{H_t\}$  and  $\{P_t\}$  are the two series to be analysed. Then the cross-correlation coefficient at lag  $k$  between  $\{H_t\}$  and  $\{P_t\}$  is given by

$$\rho_{HP}(k) = \frac{E[(H_t - \mu_H)(P_{t+k} - \mu_P)]}{\sigma_H \sigma_P}, \quad (4.3)$$

where  $\mu_H$  and  $\sigma_H$  corresponds to the mean and standard deviation of  $\{H_t\}$  and  $\mu_P$  and  $\sigma_P$  corresponds to the mean and standard deviation of  $\{P_t\}$  respectively. Interpretation of the cross-correlation coefficient is similar to that of a standard bivariate Pearson correlation coefficient, but taken at lag  $k$ .

The following plot sketches the auto-covariance and cross-covariance structures using a sample estimate of the auto-correlation function (ACF) and cross-correlation function (CCF) of the two series,  $\{H_t\}$  and  $\{P_t\}$  up to 5 lagged years.

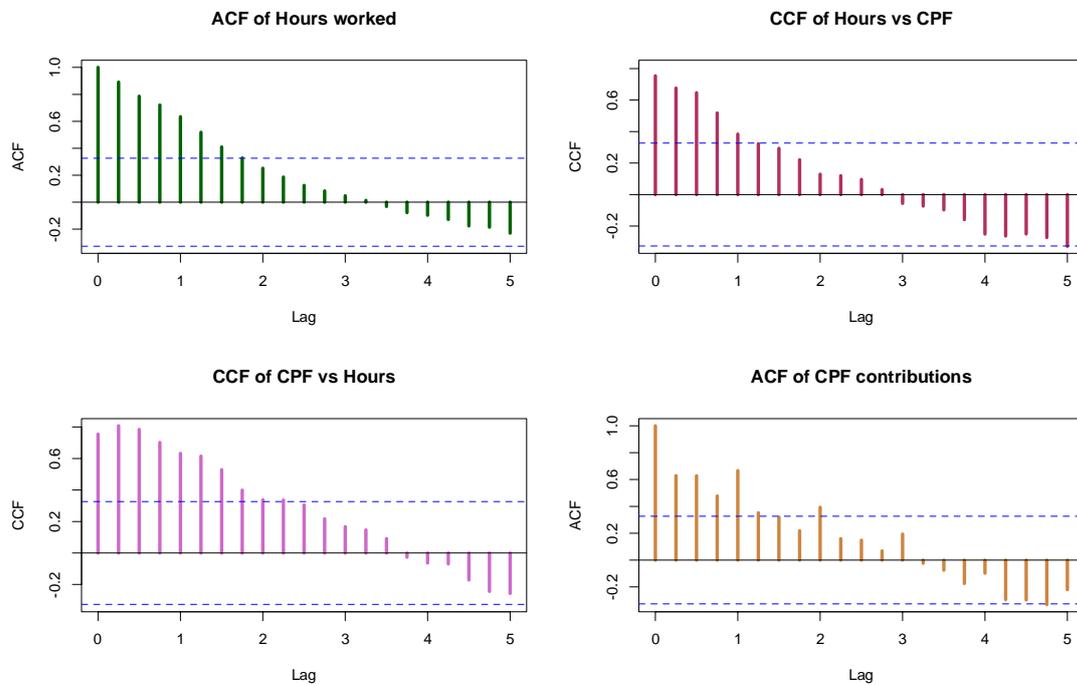


Fig 4.3 ACF and CCF of the data. Blue dashed lines indicate 95% confidence bands for the sample estimates of the ACF and CCF. Each tick mark represents the quarter-lagged sample correlation.

The ACF plots in the main diagonal indicate significant but decaying auto-correlation within the first and second lagged year, with ticks of the ACF

exceeding the confidence limits. This implies that the data presented is not merely an innovation of a random noise process but does exhibit a degree of dependence over time. In simple terms, the present value of CPF contributions or the number of hours worked per week is dependent on their immediate and recent past, though this dependence tapers rapidly with the progression of time. Furthermore, looking at the CCF plots on the off-diagonals, both series are significantly related to one another over a lagged period of time, with ticks of the CCF exceeding the confidence limits as well. In other words, lagged and present values of the CPF contributions are significantly correlated with that of the hours per week worked by the resident labour force, and vice versa. The ACF and CCF plots are useful in illuminating the covariance and dependence structure of the data and will be utilized as model identification tools in the modelling process. Again, technical details of this process are omitted for the purposes of this paper, but this section describes the intuition behind the use of the ACF in the modelling process.

### *Seasonality*

Although seasonality is absent in the labour force data through the use of seasonally adjusted figures, there is still strong seasonality evident in the CPF contributions data. This is an issue as we wish to discern the cyclic fluctuations in CPF contributions from variation that is induced from a trend, policy impact or otherwise. Box and Jenkins advocate taking seasonal differences, ie. subtracting the lagged observation from the previous year from the current observation at time  $t$ , to deal with this, but this would result in an incompatibility of the lengths of data sequences of the labour force and the CPF data. This paper has instead

elected to employ non-parametric regression in the form of Locally Weighted Scatterplot Smoothing (LOESS) as detailed in Cleveland and Devlin (1988) to "smooth" seasonal fluctuations in the CPF data. This preserves the length of the data while adjusting for seasonality.

The following plot shows a seasonally smoothed curve overlaid on the original data. As evident from the plot, the seasonal peaks corresponding to the annual spike in CPF contributions are attenuated but the rest of trend and random variation about the original data are preserved. This process thus filters the seasonal "noise" component and any co-variation in the data with the hours worked series will not be mistakenly attributed to cyclic fluctuations. Let the seasonally adjusted CPF contribution series be  $\{C_t\}$ .

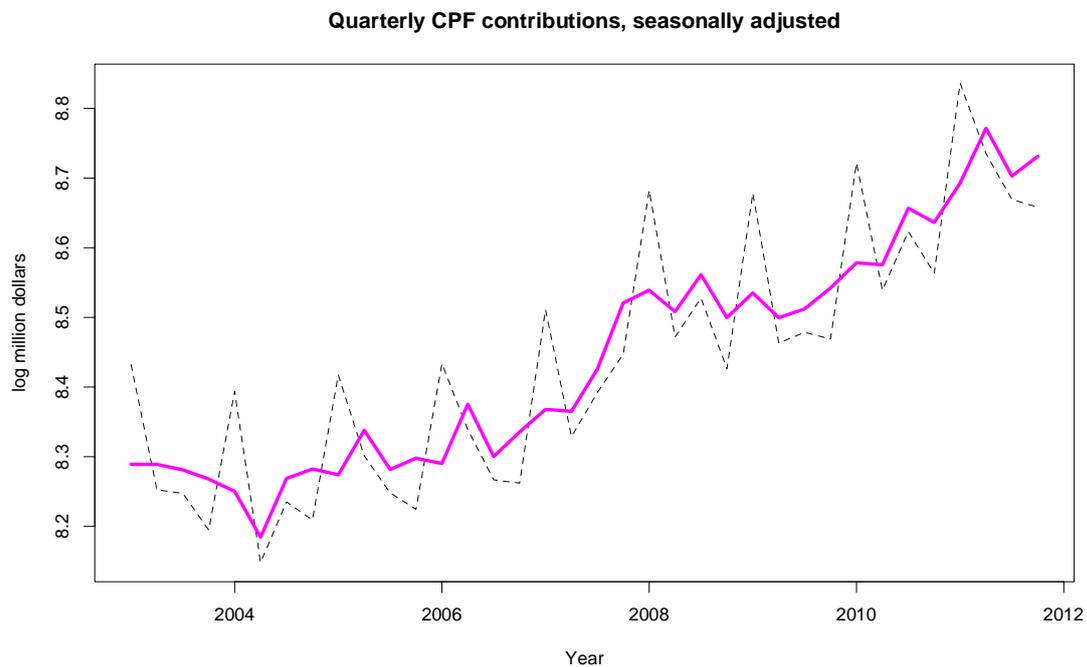


Fig 4.4. Seasonally adjusted CPF contributions using LOESS. Pink line is the seasonally adjusted series while dashed lines indicate the original series.

*Non-stationarity and co-integration*

Another common issue with time series data that is apparent in both sets of data as presented above is that of non-stationary behaviour.

Formally, a time series,  $\{X_t\}$ , with distribution function  $F_X(x_{t_1}, \dots, x_{t_k})$  at times  $t_1, \dots, t_k$  is defined to be stationary if for all  $k$  and  $h$ ,  $F_X(x_{t_1+h}, \dots, x_{t_k+h}) = F_X(x_{t_1}, \dots, x_{t_k})$ .

In other words, a time series is said to be stationary its stochastic properties or distribution are invariant to a linear time shift. A corollary of this property is that the mean of the series is independent of the time. The order of *integration*, in a time series represents the number of times a series has to be differenced to achieve a stationary series. A time series is said to have a *unit-root* if it is integrated of order of at least 1. However the data is revealed to have mean-dependence over time through the preliminary plots, with a steady upward time trend in both data series, and is likely to be non-stationary. Crucially, stationarity is a requisite for further steps in the modelling process like estimation and forecasting.

To test for stationarity, unit-root tests in the form of the augmented Dickey-Fuller (ADF) tests were performed on both variables.

| Variable                                | ADF-Statistic | $p$ -value |
|---|---------------|------------|
| Labour Supply<br>( $H_t$ )              | -2.0025       | 0.5722     |
| Gross CPF<br>Contributions<br>( $C_t$ ) | -3.2528       | 0.09465    |

Table 4.1 Augmented Dickey-Fuller Tests for main independent and dependent variable. The null hypothesis for the ADF test is that the data is non-stationary.

Looking at Table 4.1, there is insufficient evidence to reject the hypotheses that the series  $\{H_t\}$  and  $\{C_t\}$  are non-stationary, as evidenced by the  $p$ -values of 0.5722 and 0.09465 respectively. At this point, one could take differences at this point to deal with the non-stationary behaviour of the series and model the differenced series. However when dealing with two or more time series, Granger & Newbold (1974) caution that two correlated non-stationary series might be co-integrated, and running a regression between the variables will result in a spurious correlation.

Co-integration, a concept detailed in Engle and Granger (1987), is when two or more series are integrated or non-stationary but there exists a linear combination of them that has a lower order of integration. In other words, there is a common stochastic trend that is driving the perceived variation in both the series at the same time. Thus, the perceived co-variation is erroneously attributed to the two variables being strongly correlated with one another, when in fact the trend is being driven by a third variable, out of sight. Economists thus tend to view deviations from this common trend as "shocks" to the "equilibrium" relationship between one variable and another. In this context, labour supply and CPF contributions can both be driven by a common cause, which is that of the population growth. As the resident population grows in Singapore, the CPF Board gains more members and more contributions and labour supply rises as well. This needs to be distinguished from the direct impact of CPF contributions on labour supply and vice versa. To test for co-integration, Engle and Granger advocate a simple two-step procedure.

1. Regress  $H_t$  on  $C_t$ , and obtain residuals  $\hat{\varepsilon}_t$ .
2. Test for a unit root in the residuals  $\hat{\varepsilon}_t$ . If  $\hat{\varepsilon}_t$  is stationary, then  $H_t$  and  $C_t$  are co-integrated.

Here, we find that the ADF test statistic for the residuals yields a  $p$ -value of 0.6062, which indicates we cannot reject the hypothesis that the residuals are non-stationary. Thus, we can rule out the fact that the two variables are in fact not co-integrated.

In sum, the above features of the data compel us to consider different modelling approaches to deal with how to illuminate the effect of one variable on another. The following section will develop several analytical approaches for this purpose.

#### 4.4 Analytic Approach

##### *Intervention Analysis*

The first approach my paper will employ is premised on univariate analysis, relying on a single data series, which is that of the main response variable, aggregate labour supply.

Intervention analysis was introduced by Box and Tiao (1975) and has been used and applied in areas in environmental science and economics. Their method aims to articulate the *intervention effects* of external stimuli on a certain system or environment, using ARIMA models as the dynamic basis of the data generating process. Applied in the context of this paper, the number of hours worked per

week by the resident labour force is used as a measure of labour supply and the *intervention* to the system is the introduction of the WIS policy. An intervention to the system occurs at a discrete time point, and we wish to investigate if there is any evidence that the levels and the variation in the data have systematically changed *after* the variation. We could consider conducting a simple comparison of means before and after the intervention, using a Student's  $t$  test, but this involves a crucial assumption that the data are independently and identically distributed, as Box and Tiao warn in the same article. A similar regression counterpart using cross-sectional and experimental data would be regression-discontinuity (R-D) models, as introduced in Thistlewaite and Campbell (1960), but they rely heavily on typical OLS assumptions which cannot be transposed to the case for time series data, with a high degree of serial dependence and non-stationary exhibited by the data.

The following plot illustrates the idea behind such a concept.

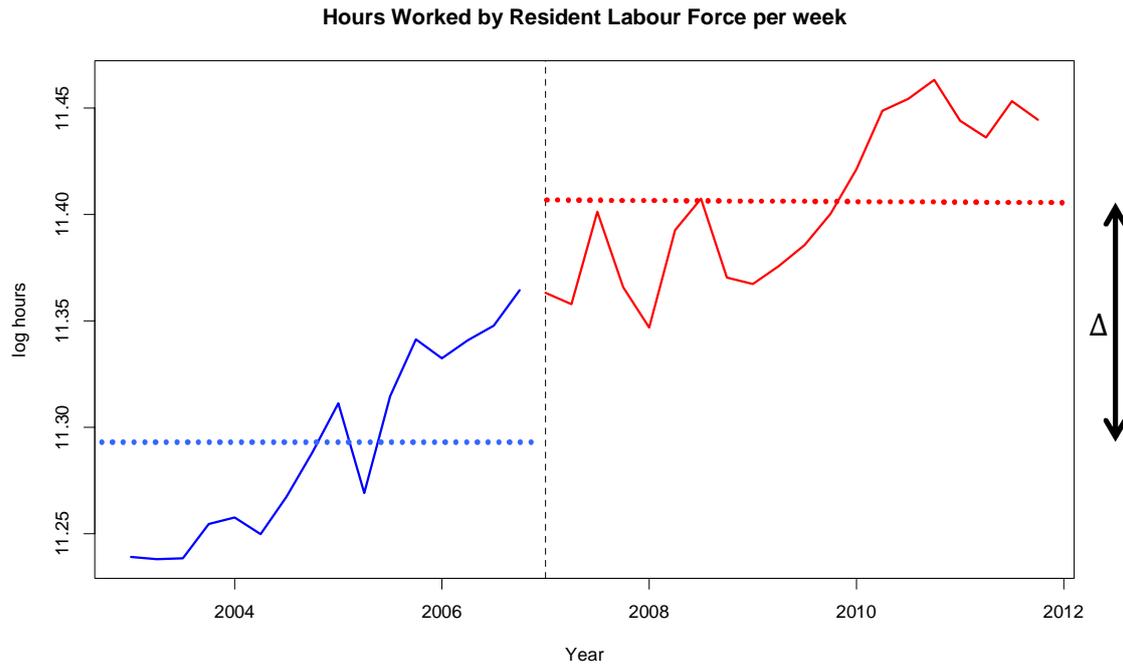


Figure 4.5. Time Series plot of Hours worked by Resident Labour Force per week. Blue portion indicates data before the WIS policy was introduced and red portion is time after WIS policy was introduced. Dashed lines indicate the mean of the series before and after the intervention.

Looking at the plot, a naive estimate of the perceived impact of the policy can be estimated to be  $\Delta$ , which can be confirmed to be significant using a simple  $t$ -test. However, this procedure is not ideal given the high serial dependence and non-stationary behaviour exhibited by the data. Instead, Box and Tiao advocate the following strategy to discern the impact of the intervention in 3 steps:

1. Formulate a ARIMA model using the Box-Jenkins modelling procedure that characterizes what is expected to occur, given that we know the consequences and the nature of the intervention.
2. Fit the model to analyse the data.
3. Check the model for goodness-of-fit and make the appropriate inferences. If the model does not fit adequately, modify the model and try fitting it again.

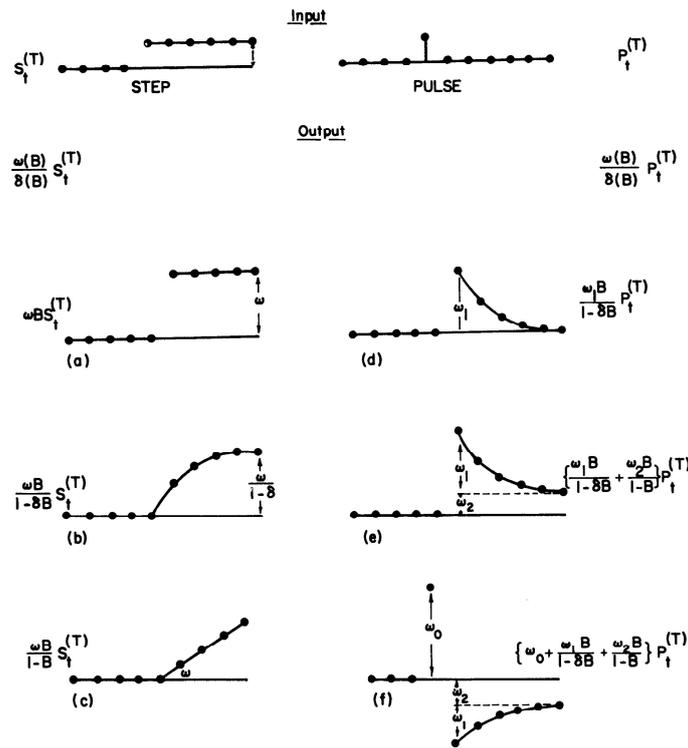
The *transfer function* represents the functional form of the intervening exogenous variable on a system, which in this case is represented by a single variable,  $H_t$ . Let this exogenous variable be  $X_t$ . Then, for an ARIMA model experiencing an intervention by  $X_t$ , the full functional form of the model is given by

$$H_t = Y_t + X_t = \frac{\omega(B)}{\delta(B)} u_t + \frac{\theta(B)}{\phi(B)} \varepsilon_t, \quad (4.3)$$

where  $H_t$  is the observed variable, labour supply, and  $Y_t$  represents the underlying variation without the influence of the WIS policy and  $X_t$  represents the intervention variable, which is the introduction of the WIS scheme.  $\{u_t\}$  is a series of i.i.d. normal random variables with mean zero and constant variance and is uncorrelated to  $\{\varepsilon_t\}$ .  $\delta(B)$  and  $\omega(B)$  are the characteristic polynomials of the series  $\{X_t\}$ , as with  $\theta(B)$  and  $\phi(B)$  for  $\{Y_t\}$ . Hence,  $\boldsymbol{\delta}$  and  $\boldsymbol{\omega}$ , which are the parameter vectors or the coefficients of the characteristic polynomials, parameterize the nature of the intervention effects of the exogeneous variable  $X_t$ .

For a policy intervention such as WIS, Box and Tiao present two possibilities for the functional form of the transfer function: a pulse or an step indicator function, where  $X_t$  can be coded as a dummy variable representing the length of the intervention. Figure 4.6 details the various outcomes for a step or pulse response to an intervention.

B. Responses to a Step and a Pulse Input <sup>a</sup>



<sup>a</sup> (a), (b), (c) show the response to a step input for various simple transfer function models; (d), (e), (f) show the response to a pulse for some models of interest.

Figure 4.6 Step and pulse response functions for various types of interventions, taken from Box and Tiao (1975).

It can be shown that the values of  $\delta$  and  $\omega$  determine the shape of the response function as in Figure 4.6. For instance, if we believed that WIS permanently raised the levels of aggregate labour supply,  $\omega = \omega_1 \neq 0$  and  $\delta = 0$ , resulting in a “step” function as in graph (a) as in Fig 4.6. If there is a gradual “first-order” increase in labour supply in response to the introduction of WIS, then  $\omega = \omega_1 \neq 0$  and  $\delta = \delta_1 \neq 0$  resulting in a gradual increase as in graph (b) in Fig 4.6. Suppose instead that the policy intervention effect was temporary and that levels of labour supply fall after some time to its original state, then we have a “pulse” function with the indicator variable taking the value of 1 at the time of the intervention, 0 otherwise, and non-zero parameters for  $\omega$  and  $\delta$ , as in graph (d).

With this, we can estimate a model that assimilates policy intervention effects to produce model parameters that can be interpreted intuitively. However, the functional form of the transfer function is highly subjective and depends on some degree of intuitive guesswork as to the nature of the intervention. This implies the following procedure to determine the nature of the intervention and for selecting an appropriate final model for the data.

1. Specify the ARIMA model for  $Y_t$ , the response variable using the data *before* the intervention.
2. Use the model to predict  $\hat{Y}_t$ , for the time period after the intervention.
3. Examine the residuals  $H_t - \hat{Y}_t$  for any clues as to what form the intervention transfer function should take.
4. Shortlist a few candidate models for the intervention and estimate all models using maximum likelihood estimation.
5. Select the best model using model diagnostic tools.

Applying Box-Jenkins modelling, we have that the best ARIMA model for the data prior to the intervention is an AR(1) model, with  $\phi = 0.9172$ . This implies that the intervention-free data, prior to 2007 when the WIS scheme was introduced, follows an AR(1) process. The residuals  $H_t - \hat{Y}_t$  were obtained and plotted in Fig 4.7 to gain a picture of the form of the transfer function and intervention effects.

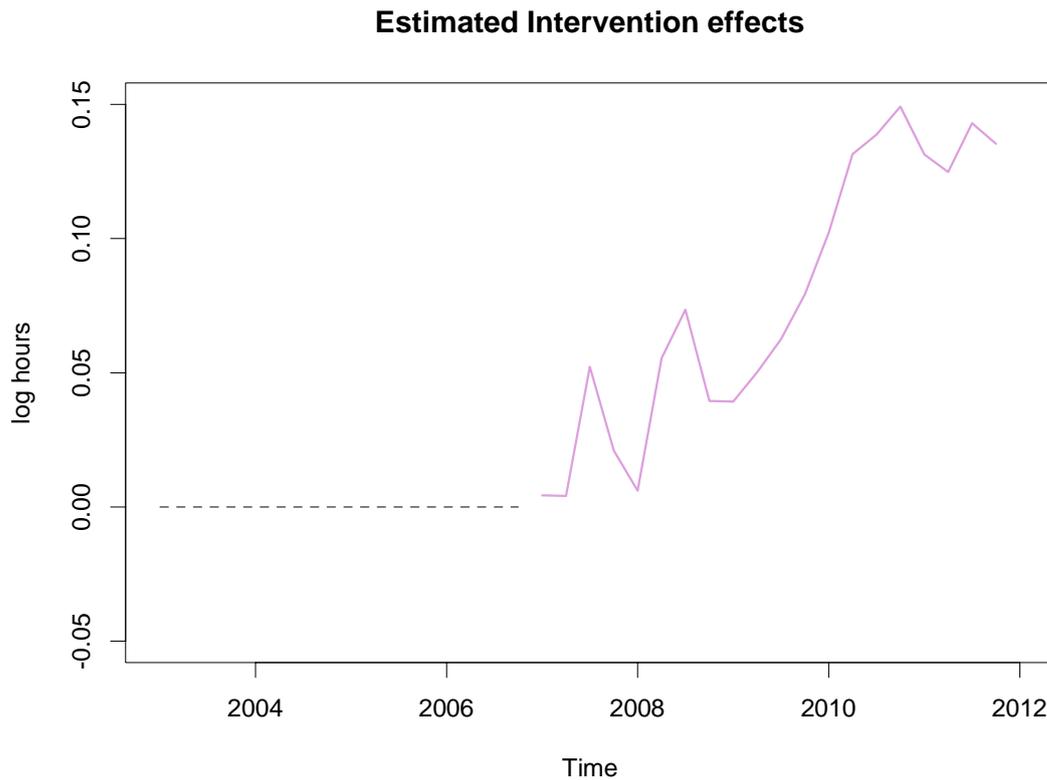


Figure 4.7 Estimated Intervention effects of the introduction of WIS in 2007 in log hours. Dashed lines indicate the baseline prior to the intervention.

Looking at the estimated intervention effects, we can speculate that WIS has permanently raised the levels of labour supply since its introduction, as the residuals show an increasing trend after 2007. This implies that we could estimate a model based on a step function rather than a pulse function. However, there is a slight fluctuation about 0 for about a year before labour supply starts to increase, implying that we could look at the intervention being delayed for a year before taking effect in 2008. For completeness, 3 possible models are entertained and the results are presented in Table 4.2.

|  |                                   |                                   |                                   |
|--|-----------------------------------|-----------------------------------|-----------------------------------|
|  | Scenario 1:<br>Permanent increase | Scenario 2:<br>Permanent increase | Scenario 3:<br>Temporary increase |
|--|-----------------------------------|-----------------------------------|-----------------------------------|

|                | in labour supply immediately after 2007 | in labour supply only after 2008 | in labour supply    |
|----------------|---|----------------------------------|---------------------|
| $\omega_0$     | 0.0034<br>(0.0226)                      | -0.0139<br>(0.0209)              | -0.0134<br>(0.0170) |
| $\omega_1$     | -0.0008<br>(0.0226)                     | 0.0506<br>(0.0209)               | -0.0311<br>(0.0170) |
| Log-Likelihood | 85.21                                   | 88.28                            | 86.8                |
| AIC            | -162.43                                 | -168.57                          | -165.6              |

Table 4.2 Three possible scenarios after the intervention of the WIS policy. Parameter estimates of the transfer functions are presented with standard errors in parentheses. AIC is the Akaike Information Criteria.

Looking at the estimates of the transfer function model parameters, there is only significant evidence to suggest that Scenario 2 provides a good characterization of the data, with the  $p$ -value of the parameter estimate of  $\omega_1$  at 0.008. The other model parameter estimates are not significant, with standard errors high in magnitude. Using the Akaike Information Criteria<sup>25</sup> (AIC), we find that the model that fits the data the best is Scenario 2, where it stipulates that a permanent increase in labour supply only takes place after 2008. Thus, we can infer from these models that since the introduction of the WIS, we can find most support for the delayed intervention effects of the policy, and that the levels of labour supply have increased since its introduction, but only after a year.

There are obvious limitations to this approach. First, estimating the impact of the intervention heavily depends on the specification of the functional form of the transfer function. This is a subjective process and requires guesswork. Second, it cannot accommodate multiple interventions. Under this approach, only one

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<sup>25</sup> The Akaike Information Criteria is used for model selection. The lower the AIC, the better the model at representing the data.

intervention can be considered at any one time and the dynamical nature of the underlying system cannot be appropriately represented. Nonetheless, the framework still provides a useful heuristic as to how the response variable has shifted since the intervention. The next section will present another approach in that will assimilate the other variable and information to a multivariate model and inferences will be made thereafter.

### *Vector Autoregression (VAR)*

VAR is a natural extension of the univariate analysis. By including other variables, we can explain the impact of the policy through the operationalization of another variable. In this context, the levels of CPF contributions, which is the main pipeline via which the WIS payments are administered will be analyzed in relation to labour supply. In multivariate analysis, Brockwell & Davis (2001) advocate "pre-whitening" the series prior to fitting a multivariate model. This involves taking differences of the series till stationarity is achieved. Thus, first differences of both  $H_t$  and  $C_t$  were taken and the following system of equations was estimated:

$$\begin{cases} \Delta H_t = \phi_{01} + \phi_{11} \Delta H_{t-1} + \phi_{12} \Delta C_{t-1} + \varepsilon_{1,t} \\ \Delta C_t = \phi_{02} + \phi_{21} \Delta H_{t-1} + \phi_{22} \Delta C_{t-1} + \varepsilon_{2,t} \end{cases} \quad (4.4)$$

(4.4) can be represented in matrix notation as in (4.2), with  $Y_t = (\Delta H_t, \Delta C_t)'$  where  $\Delta$  represents the difference operator such that  $\Delta H_t = H_t - H_{t-1}$  and  $\Phi(B) = \Phi_0 + \Phi_1 B$

with  $\Phi_0 = \begin{pmatrix} \phi_{01} \\ \phi_{02} \end{pmatrix}$ ,  $\Phi_1 = \begin{pmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{pmatrix}$  and white noise covariance matrix

$\Sigma = \begin{pmatrix} \sigma_H^2 & 0 \\ 0 & \sigma_C^2 \end{pmatrix}$ . Again, the technical details of the lag selection procedure here

is omitted in this paper and the best model given the data is selected and it follows a VAR(1) process. Table 4.3 details the parameter estimates and results from the estimation using least squares.

| Parameter estimates of VAR(1) model |                    |                   |                      |
|-------------------------------------|--------------------|-------------------|----------------------|
| $\hat{\phi}_{01}$                   | 0.0080<br>(0.004)  | $\hat{\phi}_{02}$ | 0.0152<br>(0.009)    |
| $\hat{\phi}_{11}$                   | -0.2273<br>(0.179) | $\hat{\phi}_{21}$ | 0.3247<br>(0.378)    |
| $\hat{\phi}_{12}$                   | -0.0448<br>(0.079) | $\hat{\phi}_{22}$ | -0.3507*<br>(0.0442) |

Table 4.3 Parameter estimates of the VAR(1) model. Standard errors are shown in parentheses. \* denotes that the parameter is significant at a 10% level of significance.

With these results, we can see that the parameter estimates do not show significance except for  $\phi_{22}$ , which parameterizes the lagged dependence of the level of CPF contributions on its previous level in the past quarter. The results show that lagged CPF contributions do not help to explain the variation in labour supply, and thus there is no evidence to support the hypothesis that CPF injections positively impact the levels of aggregate labour supply in the economy.

Taking the analysis further, Granger (1969) defined a concept of causality based on whether past values of one variable help to predict present values of another. A formal hypothesis test based on the *F*-distribution was formalized as the Granger-causality test. Applying the test, we find that referenced to an *F*-

distribution, we find weak evidence against the null hypothesis that the lagged values of CPF contributions do not Granger-cause a change in the levels of aggregate labour supply, with a  $p$ -value of 0.5722. This lends slight credence to the hypothesis that an injection to CPF accounts affect levels of aggregate labour supply in Singapore, in contrast to the interpretation of the VAR parameters. To take the analysis even further, we can also consider charting the *impulse-response* function, as outlined in Lütkepohl (2005). This tracks the future effects of an *exogenous* increase in one variable on another in the VAR system. Figure 4.8 charts the impulse-response dynamics of an exogenous increase in CPF contributions in a 10-step ahead horizon.

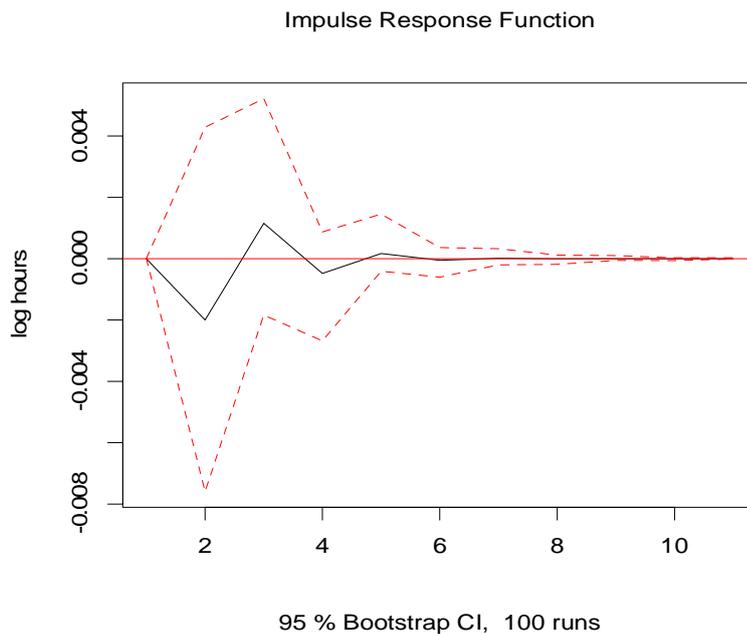


Fig 4.8 Impulse Response Function of an exogenous increase in CPF levels on the levels of labour supply. Dashed red lines indicate 95% bootstrapped confidence intervals

From the impulse-response graph, it can be seen that an exogenous increase in CPF at time zero induces a response not significantly more than zero, with the bootstrapped confidence bands including zero. The magnitude of the impact is low as well, indicating that an increase in CPF levels does not have an immediate or lasting effect on labour supply. In sum, there is little evidence to support the hypothesis that WIS, administered through the CPF pipeline has any impact on the levels of aggregate labour supply in Singapore.

## 5. Discussion

The preceding analysis has articulated how the nascent Workfare philosophy and its associated policies have had an impact on the labour supply and the willingness to work. Substantively, policymakers have an interest in asking a fundamental question: is there a trade-off between the systematization of welfare and the productivity and positive work ethic in the labour force? This paper contends that the answer is a tentative "no". The models in section 4 presented demonstrate that there is no significant impact of the introduction of the policy with the use of aggregate time series data detailing the level of CPF contributions and the number of hours worked by the resident labour force.

Yet, qualifications should be made with regard to the inferences made from these models. Firstly, aggregate data may prove to be insensitive to small fluctuations in the labour market or the levels of CPF contributions. It is therefore difficult to ascertain what the true impact of an intervention in this given system if it is small and not reflected at an aggregate level. A more detailed inquiry would require further aggregations of the data to analyze the impact across various

strata like age, race or gender categories. This would help accentuate the differentiated outcomes of the WIS policy on different sections of the target populations. This paper however, has worked within the constraints of the available data to develop a sufficient model for a macro-level diagnosis of the policy and has concluded that there has been no significant trade-off as aforementioned looking at the aggregate level. Policymakers may thus wish to consider introducing various other aggregations across different strata with the available data. Secondly, in the operationalization of labour supply, this paper has considered the number of hours worked by the resident labour force, which can prove to be problematic in its application. Primarily, this paper is concerned with the fact that the hours worked reflect the labour supply at an *equilibrium*, that is to say, assuming labour demand meets supply. However, there might be an environment in which there is insufficient demand to meet the increased supply. In other words, we find that workers who are willing to work increased hours may not get to work the extra hours that they want if firms do not wish to increase their capacity of production. Thus, the number of hours worked may not actually reflect the *willingness* to work, rather the equilibrium levels of labour supply. This is reflected in Rosen and Quandt (1975) and they detail a disequilibrium model of aggregate labour supply. They recommend that the labour market be studied in tandem with other markets in a general equilibrium system to obtain reliable estimates. One could consider extending the models as developed in Section 4 as an idea for future work along these lines.

## 6. Conclusion

While the ruling government in Singapore has been wary of institutionalizing a welfare state, the innovations in socio-political trends have bred a new brand of social policies imbued by the Workfare philosophy. This paper has developed a methodology to assess if as a social policy, the WIS scheme established under the ambit of Workfare has proven to be a viable one that has not affected the productivity and work ethic of the labour force in Singapore. Using a time series data and developing separate intervention and vector auto-regressive models, there was no significant impact of the policy on the labour supply, which was taken as a reference of the willingness to work in the resident labour force. With this, future work should look to a more comprehensive survey of the labour force across various strata and including various variables that characterize the dynamics that affect the labour market. Meanwhile, this paper hopes to have provided a useful heuristic and diagnostic tool for policymakers to assess the viability of a social policy as such within the socio-political environment of Singapore.

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